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# The Engineer.

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The Engineer

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## PUBLIC NOTICES

### Ministry of Transport.
CONSTRUCTION OF NEW ARTERIAL ROADS.

The Minister is prepared to receive TENDERS for the CONSTRUCTION of the NEW ARTERIAL ROADS, known as
(1) THE KINGSTON BY-PASS, and
(2) THE SUTTON BY-PASS, both in the County of Surrey.

Specifications, bills of quantities and forms and conditions of Tender may be obtained from the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1, upon payment of a deposit of One Hundred Pounds in respect of each scheme. This amount will be returned to the tenderer, if his Tender is a bona fide one, and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.

Conditions of contract and the drawings may be inspected at the Ministry between the hours of 10 a.m. and 4 p.m.

Tenders must be on the official form, each Tender in a sealed envelope marked "Tender for Kingston By-pass" or "Tender for Sutton By-pass."

Tenders must be accompanied by the specification and bill of quantities.

Each Tender must be signed in the handwriting of the tenderer or his authorised agent.

The Minister does not bind himself to accept the lowest or any Tender.

Tenders must reach the undersigned by 10 a.m. on Saturday, the 28th of April, 1923.

Dated this Fifth day of April, 1923.

H. H. PIGGOTT,
Assistant Secretary.

Ministry of Transport. 2084

### University of Liverpool.
Session 1923-1924.

FACULTY OF ENGINEERING.

DEAN: Prof. T. E. ABELL, O.B.E., M.Eng., F.C.N.C., Hon., M. Inst. M.A.

Prospectus and full particulars of the following may be obtained on application to the REGISTRAR:—Engineering, Thermodynamics of Heat Engines, Strength of Materials, Electrical Engineering, Civil Engineering, Naval Architecture, Metallurgy, Geology, Marine Engineering, Design and Drawing, Refrigeration, Mathematics, Physics, Chemistry. 2041

### Borough of Torquay Electricity DEPARTMENT.

4th April, 1923.

The Corporation invite TENDERS for the SUPPLY, DELIVERY, and ERECTION of:—
ONE 15-TON OVERHEAD TRAVELLING CRANE for Newton Abbot Power Station, Teign-road, Newton Abbot.

Copies of specification, conditions of contract, and form of Tender may be obtained from Mr. H. F. G. Woods, Borough Electrical Engineer and Manager, Town Hall, Torquay, on payment to him of a deposit of £2 2s. The deposit will be returned in full upon the receipt of a bona fide Tender.

Extra copies of the specification may be obtained on payment of 10s. 6d. per copy.

All Tenders, endorsed "Crane," must be received not later than Noon on Friday, the 27th inst.

The Corporation do not bind themselves to accept the lowest or any Tender.

HERBERT A. HIELD,
Town Clerk.

Town Hall, Torquay. 2080

### County Borough of Burton-UPON-TRENT.
BURTON BRIDGE WIDENING.
CONTRACT NO. 1.

The Corporation of Burton-upon-Trent invite TENDERS for the WIDENING of BURTON BRIDGE across the valley of the River Trent in FERRO-CONCRETE on the Hennebique system, from substantial and responsible contractors who shall be authorised to execute ferro-concrete construction on that system.

The bridge consists of six arches, 45ft. span, and twenty-six arches of 26ft. span, the total length being about 1200ft., and the width of the proposed widening is 20ft., with a triangular extension at the east end averaging 15ft. in width.

Drawings may be seen and specifications, conditions of contract, bills of quantities, and forms of Tender may be obtained at the office of the undersigned on and after the 16th April, 1923, on deposit of a Ten Pound Bank of England note, which will be returned after receipt by the Corporation of a bona fide Tender with schedule of prices filled up and bill of quantities fully priced in.

No Tender will be accepted from any person who pays his employees (whether artisans or labourers) less than the standard rate of wages paid in this borough, or who does not conform to the hours and conditions of labour generally recognised as fair in each branch of industry affected, and clauses to ensure compliance with this regulation are inserted in the conditions of contract.

The Corporation do not bind themselves to accept the lowest or any Tender.

Tenders, properly endorsed, must be delivered at my office not later than 5 p.m. on Tuesday, 1st May, 1923.

GEORGE T. LYNAM, M. Inst. C.E.,
Borough Engineer and Surveyor.

Town Hall, Burton-upon-Trent,
29th March, 1923. 2065

### Metropolitan Water Board.
TENDERS FOR COAL AND ASH-HANDLING PLANTS, AUXILIARY BOILER, PIPING, &c., AT LITTLETON PUMPING STATION.

The Metropolitan Water Board invite TENDERS for the MANUFACTURE, DELIVERY, and FIXING of COAL and ASH-HANDLING PLANTS, AUXILIARY BOILER, PIPING, &c., at their Littleton Pumping Station.

Forms of Tender, conditions of contract, specification, and drawings may be inspected without payment of fee at the offices of the Board, Chief Engineer's Department, Room 192, New River Head, 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Monday, April 9th, 1923.

Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £1 1s., which sum must be deposited with the Board's Accountant, and will be returned on receipt of a bona fide Tender, together with all incidental papers. Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon).

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Coal Conveyor, &c., Littleton," must be delivered at the offices of the Board not later than 10 a.m. on Monday, 30th April, 1923.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
New River Head,
Rosebery-avenue, E.C. 1.
29th March, 1923. 2076

## PUBLIC NOTICES

### County Borough of SOUTHAMPTON.
TENDER FOR LAYING WATER PIPES.

The Corporation invite TENDERS for the LAYING (and JOINTING) of about 2300 LINEAL YARDS of WATER MAINS between Allbrook and North End, Eastleigh.

Forms of Tender, specification, and bill of quantities with schedule may be obtained and drawings inspected at the Waterworks Engineer's Office, 21, Shirley-road, Southampton, on and after the 4th proximo, upon production of the Borough Treasurer's receipt for a deposit of £1 1s. Deposits will be returned after the Council have dealt with the Tenders to contractors who have submitted bona fide Tenders, together with the return of all documents supplied.

Sealed Tenders, endorsed "Tender for Allbrook to North End Main," must be delivered at the Town Clerk's office not later than 10 a.m. on the 19th proximo. No pledge is given to accept the lowest or any Tender.

R. R. LINTHORNE,
Town Clerk.

29th March, 1923. 2053

### County Borough of SOUTHAMPTON.
TENDERS FOR C.I. PIPES AND SPECIALS.

The Corporation invite TENDERS for the SUPPLY of about 235 TONS of 12in. diameter C.I. S. and S. PIPES and SPECIAL CASTINGS.

Form of Tender, specification, bill of quantities and schedule may be obtained at the Waterworks Engineer's Office, 21, Shirley-road, Southampton, on and after the 4th proximo, upon production of the Borough Treasurer's receipt for a deposit of £1 1s.

Deposits will be returned after the Council have dealt with the Tenders to contractors who have submitted bona fide Tenders, together with the return of all documents supplied. Sealed Tenders, endorsed "Tenders for C.I. Pipes and Special Castings," must be delivered at the Town Clerk's office not later than 10 a.m. on the 19th proximo.

No pledge is given to accept the lowest or any Tender.

R. R. LINTHORNE,
Town Clerk.

29th March, 1923. 2054

### Liverpool Corporation Water-WORKS.
TRUNK MAIN FROM PRESCOT TO LIVERPOOL.
CONTRACTS NOS. 3 AND 6.
TO STEEL BRIDGE AND STEEL WATER TUBE MANUFACTURERS.

The Water Committee of the Liverpool Corporation is prepared to receive TENDERS from manufacturers for the SUPPLY of the following STEEL WORK, viz.:
CONTRACT No. 3.—STEEL PLATE GIRDER BRIDGE to carry a total distributed load of 40 tons, clear span 71ft.
CONTRACT No. 6.—TWO STEEL TUBES of 40in. internal diameter, each of a total weight of about 18 tons.

The plans may be inspected and copies of the specification and form of Tender for each Contract obtained on and after Monday, 9th April, 1923, at the Water Engineer's Office, Alexandra Buildings, 55, Dale-street, Liverpool, upon payment in each case of the sum of Two Guineas, which amount will be returned upon receipt of a bona fide Tender and return of the documents and drawings issued.

Tenders, endorsed "Tender for Steel Bridge" and "Tender for Steel Tubes," respectively, are to be sent through the post in a sealed envelope addressed "Chairman of the Water Committee, Town Clerk's Office, Municipal Buildings, Liverpool," so as to be delivered not later than Twelve o'clock Noon on Tuesday, the 24th day of April, 1923.

The Water Committee do not bind themselves to accept the lowest or any other Tender.

W. MOON,
Town Clerk.

Municipal Buildings, Liverpool,
7th April, 1923. 2061

## PUBLIC NOTICES

Department of Public Works,
Sydney, 31st January, 1923.

SYDNEY HARBOUR BRIDGE TENDERS—EXTENSION OF TIME.

### Tenders are Invited by the

Government of New South Wales for the CONSTRUCTION of the SUPERSTRUCTURE and SUBSTRUCTURE of a CANTILEVER BRIDGE across Sydney Harbour from Dawes Point to Milson's Point, embracing a main span of 1600ft. in the clear, centre to centre of main piers, and a length of main bridge 2000ft. centre to centre of anchor piers. The total length of main bridge and approach spans included in Tender is 3810ft.; also an ALTERNATIVE TENDER for the CONSTRUCTION of the SUPERSTRUCTURE and SUBSTRUCTURE of an ARCH BRIDGE across Sydney Harbour from Dawes Point to Milson's Point, embracing a main span of 1650ft. in the clear, centre to centre of bearings. The total length of main bridge and approach spans included in Tender is 3770ft. Either bridge is to provide for four lines of railway, six lines of vehicular traffic, and footway accommodation.

Copies of specification, including plans, technical information, general conditions, and Tender forms, may be obtained by bona fide tenderers on application to the Under-Secretary for Public Works, Sydney, or to the Agent-General for New South Wales, Australia House, The Strand, London; the Minister of Railways and Canals, Ottawa; the Australian Trade Commissioner in the United States, New York; or the Bureau of Foreign and Domestic Commerce, Washington, D.C., United States.

Tenders, the time for which has been extended, must reach the Under-Secretary for Public Works, Sydney, New South Wales, not later than 30th November, 1923.

R. T. BALL,
2035 Minister for Public Works and Railways.

### The South Indian Railway Company, Limited,

are prepared to receive TENDERS for the SUPPLY of:—
1. STEEL WORK for BRIDGES (Bridge over Madura River).
2. DITTO (Arkonam Branch).
3. DITTO (Footbridge at Tinnevelly).
4. GALVANISED CORRUGATED SHEETS, &c.
5. PAINTS, &c.
6. MOIST WHITE LEAD.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Bridge over Madura River," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 20th April, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of each specification.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
3rd April, 1923. 2051

### "THE ENGINEER" WANTED.

WANTED, a COPY of "THE ENGINEER" for June 16th, 1916.—Write, R. C., c/o Street's, 30, Cornhill, E.C. 3. 2064

## PUBLIC NOTICES

TO METAL MERCHANTS AND OTHERS.

### The Rhyl Urban District

Council are prepared to receive OFFERS for the TAKING DOWN and REMOVAL of about 260 YARDS of the RHYL PIER, including the PIER HEAD.

Particulars and conditions may be obtained from the undersigned.

Sealed Offers, endorsed "Rhyl Pier," to be delivered not later than the 21st instant.

T. AMOS JONES,
Clerk to the Council.

Council Offices, Rhyl,
3rd April, 1923. 2060

### Shanghai Municipal Council.
PUBLIC WORKS DEPARTMENT.
CLERKS OF WORKS.

FOUR fully qualified CLERKS of WORKS are REQUIRED in the Public Works Department of the Shanghai Municipal Council. Candidates must be about 30 years of age and unmarried. Preference will be given to applicants thoroughly experienced in sewer construction and general engineering work.

Salary, Taels 285 per mensem, under a three years' agreement, which is renewable at a higher salary in the event of satisfactory services. Second-class passage is granted, with half-pay during voyage. Free medical attendance is provided, and the employee participates in the benefits of a superannuation fund. A tael at the present rate of exchange equals 2s. 1d. Exchange is, however, subject to fluctuation. Taels 285 per mensem at exchange 2s. 1d. is equivalent to about £527 per annum.

Particulars of the appointments and also full details as to the benefits enjoyed by municipal employees under their terms of service may be obtained from the Council's Agents, and applications, in candidates' own handwriting, with full information as to experience, &c., accompanied by copies of at least three recent testimonials, and endorsed "Clerk of Works" on the cover, should be forwarded at the earliest possible moment to

Messrs. JOHN POOK and CO.,
Agents for the Municipal Council of Shanghai.
2063 68, Fenchurch-street, E.C. 3.

## SITUATIONS OPEN

WANTED by an Important Firm of Electric Crane Manufacturers in their London office, SEVERAL First-class LEADING DRAUGHTSMEN; a good wage will be paid to suitable applicants.—Address, giving full particulars of experience and state age and salary required, 2092, The Engineer Office. 2092 A

WANTED, First-class MACHINE SHOP INSPECTOR, by large Electrical Manufacturers in the Midlands; one used to viewing and examining the larger machine parts of electrical machines. Only high-grade men with experience in maintaining a high standard of machine shop practice need apply. State age, wages, and experience.—Address, 1967, The Engineer Office. 1967 A

WANTED, for West Coast of South America, GENERAL MECHANIC, not under 26 years of age and single. Must have drawing-office experience and be a competent Mechanical Draughtsman. Salary £20 per month and board and lodging.—Write, "L.," c/o Street's, 30, Cornhill, E.C. 3, with testimonials. 2078 A

WANTED, for Egypt, ASSISTANT MECHANICAL ENGINEER, British, public school education, gentleman, thorough general workshop experience essential, age 29-34, unmarried preferred; salary £340-£600.—Write, DREDGING CO., 32, Sharia Wabour el Miah, Cairo, Egypt. P7102 A

ASSISTANT LOCOMOTIVE SUPERINTENDENT WANTED for Railway in Chile; healthy climate; age 28 to 30; must be good Draughtsman, with general experience; knowledge of Spanish an advantage. Salary with living allowance equal to £500 per ann.; four years' agreement; first-class passages out and home.—Address, giving full particulars of experience, with copies of testimonials, to "A. L. S.," c/o Streets, 30, Cornhill, London, E.C. 3. 2089 A

EXPERIENCED ARMATURE WINDER WANTED for Inspection Work. Must be a thoroughly competent tradesman, familiar with all classes of Armature and Field Coil Winding, including Turbo-alternator Work.—Address, 2082, The Engineer Office. 2082 A

FIRM of Standing REQUIRE TRAVELLING REPRESENTATIVE; must be mechanical; irreproachable references and good address.—Address, 2098, The Engineer Office. 2098 A

IRON and BRASSFOUNDERS Should Obtain the "Foundryman's Educator on Mixings of Metals, Alloys and Iron Productions." We are helping others. Why not help you to secure better positions. F.F. 6s.—Harefield Hall, Heywood, Lancs. P7200 A

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## SITUATIONS OPEN (continued)

WORKS MANAGER REQUIRED for Large Modern Railway Carriage and Wagon Works. Applications will only be considered from men who have successfully occupied a similar position and who are thoroughly acquainted with up-to-date methods of manufacturing the highest grades of railway carriage and wagon work. Applications will be treated as being strictly confidential.—P7194, The Engineer Office. P7194 A

WANTED AT ONCE, a DRAUGHTSMAN, Having extensive experience in Woodworking Machinery.—Address, stating experience, &c., 2045, The Engineer Office. 2045 A

WANTED, a JIG and TOOL DRAUGHTSMAN, used to all classes of Electrical Machines. Only those with sound experience on this class of work need apply. State age, experience, and wages required.—Address, 2081, The Engineer Office. 2081 A

WANTED IMMEDIATELY, JUNIOR DRAUGHTSMAN and TRACER, with some experience in Reinforced Concrete.—Apply by letter only, stating age, experience, and wages required, to K. HOLST and CO., 1, Victoria-street, S.W. 1. 2091 A

A CAPABLE CARRIAGE and WAGON DRAUGHTSMAN REQUIRED by important Argentine Railway, age 26-30. Salary £300 to £350, with an additional £50 when able to converse in Spanish, free passage.—Write, stating age, education, training, experience, &c., to Box "B. R.," c/o Davies and Co., 95, Bishopsgate, E.C. 2. 2072 A

A SENIOR LEADING CARRIAGE and WAGON DRAUGHTSMAN REQUIRED by important Argentine Railway; must be capable of taking charge during absence of chief; age 28-32. Salary £400-£450, with an additional £50 when able to converse in Spanish, free passage.—Write, stating age, education, training, experience, &c., to Box "B. R.," c/o Davies and Co., 95, Bishopsgate, E.C. 2. 2071 A

DRAUGHTSMAN REQUIRED, with Good Experience of Elevating and Conveying Machinery. Worcestershire.—Address, 2042, The Engineer Office. 2042 A

DRAUGHTSMAN for Designing Jigs and Tools. Must have had previous experience in connection with Valve production. Temporary engagement.—Reply by letter in first instance, stating experience, age, and wage required, to UNITED BRASS FOUNDERS and ENGINEERS, Ltd., Ormskirk, Lancs. 2044 A

DRAUGHTSMAN, SENIOR, for A.C. and D.C. Machines.—Address, stating age, experience, salary required and when can commence, P7215, The Engineer Office. P7215 A

DUST REMOVAL.—Westminster ENGINEERING FIRM REQUIRES CHIEF DRAUGHTSMAN with extensive theoretical and practical knowledge of Ventilating, Heating, and Dust Removal Plants. Must be able to design and estimate complete installations. State fully training, experience, age, salary required, &c.—Address, 2039, The Engineer Office. 2039 A

MACHINE TOOL DRAUGHTSMAN, for Firm in the Manchester district. Must be widely experienced and capable of designing special Machine Tools. Intimate experience of many classes of machine tools essential; detailers need not apply. Good prospects for suitable man.—Address, 1995, The Engineer Office. 1995 A

SWITCHGEAR DRAUGHTSMEN.—First-class MEN WANTED by Firm in N.W. London, with experience in Design and Lay-out of Up-to-date Switchgear. Only men with sound practical and technical training need apply. Good openings for really first-class men.—Address, stating age, experience, and salary required, 1988, The Engineer Office. 1988 A

WANTED, Energetic WORKING FOREMAN BLACKSMITH for General Structural Engineers in Midlands. Must be capable of improving methods and fixing prices. State age, experience, and references, also salary required.—Address, 1979, The Engineer Office. 1979 A

BLUEPRINTING MAN WANTED, to Take Charge of Manufacturing Engineers' Blueprint Room and Drawing Files. Knowledge of Hall's Rotary Machines and Modern Blueprinting, Photostatic, and Reproduction Processes essential, together with experience of routine filing and card indexing.—Address, stating age, experience, and salary required, P7132, The Engineer Office. P7132 A

BLACKSMITH WANTED for Peru; Thorough Knowledge of Machine Drill Sharpening and Tempering of Drill Steel essential, also familiar with drill parts and able repair air drills. Salary 225 dols.; U.S. currency, monthly. Highest references.—Write, "H. R.," c/o Street's, 30, Cornhill, E.C. 3. 2040 A

## SITUATIONS WANTED

WANTED by a Mechanical Engineer, CHARGE of FACTORY PLANT, Boilers, Gas or Steam, or manage small country engineering shop and foundry.—Address, P7213, The Engineer Office. P7213 B

ADVERTISER, Qualified Mechanical Engineer-draughtsman (34), WANTS POST as Assistant Works Manager or Engineer; 10 years' experience in steam, electrical, and I.C. plant; held similar appointments at home and abroad; lately engaged on asphalt manufacture; salary £450 to start; good refs., war service in R.E.s.—Address, P7183, The Engineer Office. P7183 B

CIVIL ENGINEER (28), with Experience in Switzerland, Germany and France, DESIRES APPOINTMENT for Waterworks and Reinforced Concrete.—Address, Box 117, Smith's Library, Harrogate. P7189 B

CONSTRUCTIONAL and MAINTENANCE ENGINEER (30) DESIRES POST; Works Manager or with firm of Consulting Engineers. Excellent experience in the erection of chemical, steam and electrical plants, steel, R/F con., gas producers, furnace work, D.O., and surveying. Either home or abroad. Keen and energetic; good linguist.—Address, P7201, The Engineer Office. P7201 B

CONSTRUCTIONAL ENGINEER, Hungarian, at present in Hungary (28), WANTS APPOINTMENT; passage paid, any work anywhere at half usual salary; speaks English, French and German.—Reply, MENGELE, 47, Cadogan-place, S.W. 1. P7184 B

ENGINEER (English), Experienced in Patent Law and practice, sound knowledge of technical and chemical German, DESIRES SUITABLE SITUATION, whole or part-time, London or provinces.—Address, P7211, The Engineer Office. P7211 B

ENGINEER, M.I. Mech. E., Now Representing Well-known firm in the London area, DESIRES similar or other suitable POST; 30 years' practical and commercial experience, including 16 years' works and general management.—Address, J., 29, Westbourne-gardens, W. 2. P7210 B

ENGINEER (Working) SEEKS SITUATION. Good all-round experience, fitting, turning, charge of plant; 1st Class B.O.T. Certificate.—FRANCIS, 3, Riverdale-road, Twickenham, Middlesex. P7190 B

ENGINEER, Young, REQUIRES APPOINTMENT; first-class fitter and turner, gas, steam and petrol engines, also general repair work, maintenance or construction.—Address, P7208, The Engineer Office. P7208 B

EXPERIENCED MECHANICAL ENGINEER (33), A.M.I.M.E., highest references, SEEKS SUPERVISORY APPOINTMENT, home or abroad; held responsible positions in well-known firms; 9 years shops, 7 years drawing-office, 6 years management.—Address, HOWARD, 90, Victoria-street, S.W. 1. P7195 B

## SITUATIONS WANTED (continued)

MARINE ENGINEER, Ex-Navy, 2nd B.O.T. Certificate, SEEKS BERTH, anything, anywhere; wages secondary consideration.—Address, P7187, The Engineer Office. P7187 B

MECH. ENGINEER (37), 10 Years Diesels, Electrical, mining, refrig., up-to-date shop and factory experience, good disciplinarian and economist, SEEKS ENGAGEMENT, erection, maintenance, or foreman.—Address, P7209, The Engineer Office. P7209 B

DESIGNING DRAUGHTSMAN (32), Competent man, shop trained, widely experienced, DESIRES POST, London district. Specialist in new and original design, all classes machinery. Lowest salary £5 10s.—Address, P7196, The Engineer Office. P7196 B

DRAUGHTSMAN (London District) SEEKS SITUATION; 18 years' good all-round engineering experience in shops and drawing-office.—Address, P7218, The Engineer Office. P7218 B

DRAUGHTSMAN (Mechanical), Wide Experience in design and lay-out of various industrial plants, power station design, general engineering, DESIRES SITUATION.—Address, P7216, The Engineer Office. P7216 B

WANTED, a POSITION as MACHINE SHOP FOREMAN by a man with 12 years' first-class experience as such and who knows how to get the best from both men and machines; England preferred.—Address, P7185, The Engineer Office. P7185 B


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PARTNERSHIPS and ACTIVE DIRECTORSHIPS WANTED in Mechanical, Constructional, Electrical Engineers, &c., for Clients with technical experience and capital from £1000 to £50,000.—GILBERT and PRATT, 18, Walbrook, London, E.C. 4. Ex C

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Premises most conveniently situated near Brighton, at one of the leading yachting stations on the South Coast.
Lease of Engineers' Shop, Building Shed and Stores, and Laying-up Ground, with Machinery, Stock and Plant, can be acquired on most advantageous terms.
Address, P7199, The Engineer Office. P7199 C

WELL-KNOWN INSURANCE COMPANY will CONSIDER DEBENTURES up to £250,000 on Old-established Business. Write in confidence.—Address, 2074, The Engineer Office. 2074 C

## AGENCIES

WANTED, AGENTS' REPRESENTATIVES for Patented Machine. Effects a tremendous saving, sells at sight. Every factory a user. Good commission basis.—HARLIE BROS., 183, Dalston-lane, London, E. 8. P7202 D

AGENCY for Machinery or Structural Work WANTED by university graduate (36); sound practical and sales experience, good connection.—L. G. SEWELL, B.E., Abbey House, 2, Victoria-street, London, S.W. 1. P7205 D

GENTLEMAN, with Sound Connection Amongst steel tube users, London, would REPRESENT FIRM similarly interested.—Address, P7207, The Engineer Office. P7207 D

TOOL MERCHANTS and DISTRIBUTORS are INVITED to APPLY for BUYING AGENCIES for United Kingdom and British Colonies for novel, simple, and provisionally patented HAND TOOL for COILING TENSION and COMPRESSION SPRINGS.
Stocks now available for placing on market.
Address, P7177, The Engineer Office. P7177 D

WELL-KNOWN FRENCH FIRM REQUIRES AGENTS all over the British Isles to sell Milling Cutters on commission. Previous experience absolutely necessary.—Apply, R. A. M. RONCERAY, 195, Bristol-road, Birmingham. P7186 D

## EDUCATIONAL

APPRENTICESHIP REQUIRED in Draughtsman's office for youth (16) with technical knowledge and good secondary school education.—ANDERSON, 19, Vartry-road, Stamford Hill, N. 15. P7220 E

CORRESPONDENCE COURSES for Inst. C.E. Inst. Mech. E., London Univ. (Matric., Inter., and B.Sc.) personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Assoc. M. Inst. C.E., M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams. Courses may commence at any time.—8/11, Trafford Chambers, 58, South John-street, LIVERPOOL. Ex E

LEARN SURVEYING AND LEVELLING.—Thorough practical instruction given by an expert.—Address, E. MOUL (late L.S.W. and S.P.D. Rlys.), Hollybank, Woking. P6954 E

## MISCELLANEOUS

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## PATENTS

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For continuation of For Sale Advertisements see page 3.

## MARCH.

### The Air Estimates.

The Air Estimates for 1923–24, presented to Parliament on the 8th and debated on the 14th, revealed many interesting facts, among which that to attract chief popular attention was a statement showing the great disparity between Britain's aerial strength and that of France. At the time of the Armistice, the two countries possessed approximately the same number of service machines, 3300 and 3600 respectively. To-day, the British strength has fallen to one-tenth of the war-time figures, whereas the French have reduced their strength only to one-third. Moreover, of our thirty-four service squadrons, twenty-four are stationed overseas, whereas three-quarters of the French machines are in France. Apart from this revelation, the most interesting news, especially to the aircraft industry, was the announcement that during the year it was proposed to expend a total sum of £3,620,000 upon the purchase of aircraft, aero-engines and spare parts. This amount exceeds the corresponding figure for the previous year by nearly three million pounds. Not far short of two millions is to be spent on the purchase of complete machines, and about one million on complete engines. About a quarter of a million is to be allocated to research and experimental work. The total estimated expenditure amounts to £18,605,000, but appropriations in aid—that is, the sums received by the sale of wartime material and otherwise—will reduce this figure to a net total of £12,011,000, or £1,116,000 more than in the previous year. The strength of the Air Force, all ranks, is to be increased from 31,176 to 33,000. On civil aviation £287,000 is to be spent. Under this head, Sir S. Hoare, the Secretary for Air, spoke with two curiously contradictory voices. He believed, he said, that civil aviation could in future be a very valuable asset to us, but he hastily added that it would never become a substitute for military aviation or provide a first line of defence against aerial invasion. As a means of providing a reserve of pilots and machines, the subsidisation of civil aviation had, he stated, not produced the results anticipated for it by some. By the end of this year, £600,000 would have been expended on the subsidies, but only eighteen pilots and twenty machines were engaged in the work.

### Desert Traction.

The journey undertaken by five motor cars with endless rubber tracks from Algeria across the Sahara Desert to Timbuctoo might be regarded in the nature of a special effort which was only rendered possible by good organisation; but when the same vehicles returned from the Niger Valley to Algeria by the same route, apparently without incident, and finished up the journey from Marseilles to Paris, there are good grounds for believing that this method of locomotion has definitely solved the problem of travelling over regions inaccessible to other vehicular traffic. There is nothing special in the vehicles themselves, or in the principle of the endless track, which owes its efficiency to the rubber band with inside triangular section engaging in a groove in the motor pulley and the loose pulley, and kept in contact with the ground by four jockey rollers. The experiment has demonstrated that there is nothing to fear from the introduction of sand into the bearing parts of the engine and vehicle or from the deterioration of the rubber track from the extremely high temperatures and the abrasive action of the sandy desert. In view of the results obtained, the Compagnie Générale Transatlantique has decided upon experimenting with similar cars next autumn with the idea of bringing a much wider range of the desert within the touring itineraries. It is hoped that the new system of traction will prove particularly valuable in association with desert flight by replenishing stores along the route and thereby permitting of rapid communication between North Africa and the Niger Valley.

### A Railway Collision in a Fog.

The report of Colonel Pringle on a collision during a dense fog on January 17th was issued on the 9th. This mishap occurred at Queen's-road West signal-box on the South-Western section of the Southern Railway, and arose through the driver of the up Havre boat train passing the home signal at West London Junction at "danger." This case differed in one respect from the Retford collision mentioned in the Notes for February in our issue of March 2nd. In the present instance the fogmen were out. It was like Retford, though, in that the rules for fog signalling were again found to be inadequate. This particular signal had an upper stop arm for West London Junction and a lower distant for Queen's-road West, and if both arms were "on" there was the same fog signal warning as when the stop arm was "off" and the distant "on." Reliance is placed on the fogman verbally to caution the driver, but the rule only says what it to be done when the upper arm is "off;" nothing is said as to the fogman's duty when the upper arm is "on," as happened in the case under review. We suppose that is left to the man's sense. How, too, can a man who has to signal for two lines warn a driver when other trains are passing? In this instance the fogman said he shouted; the driver did not, however, hear him, and consequently assumed that the detonator he heard was repeating only the "distant." Where a line is fog-signalled by machine, more detonators, after the first, can be placed on the rail as a pronounced warning when the stop signal is being passed at "danger." But the man at West London Junction failed to adopt that course. Where, however, the detonators are laid by hand it is obvious that more than one cannot be laid. This incident has led Colonel Pringle to suggest that a "distant" in the "on" position should be indicated by one explosion and a stop signal at "danger" by two. This practice, as Colonel Pringle observes, could only be followed if the companies were satisfied that their detonators would always explode. It was to guard against any failure that the detonators were used in duplicate, and some railways still lay a second fog signal. Of course, the remedy for all difficulties is to provide automatic train control. We believe that the Retford collision has stirred the companies to action in this matter, and that a committee to standardise the locomotive and track equipment is to be appointed.

### The Inchinnan Bridge.

The new Inchinnan rolling lift bridge, which replaces the old double-swing bridge over the Cart, near Renfrew, is, from the point of view of road as well as water transport, an important acquisition to the West of Scotland. Designed and constructed by Sir William Arrol and Co., Limited, the new structure was opened for traffic towards the end of March, nearly twenty months after the work on the temporary bridge and on the demolition of the old bridge was begun. The work of preparing the new foundations occupied a little under a year, while the steel structural work, which was delayed by a shortage of material occasioned by labour troubles and the engineers' lock-out, was, when once started, completed within six months. A single 20ft. carriageway provides for a double line of traffic and two side footways accommodate foot passengers. The waterway, which in the old bridge was restricted to a little over 48ft., has now been enlarged to 90ft. clear between the wooden fenders. With the electrically driven operating machinery installed, the bridge may be opened or closed in less than three minutes, and power for this purpose is taken from the adjacent mains of the Clyde Valley Electric Supply Company, Limited. The handling during opening and closing is made very simple by means of a series of electrically controlled interlocking devices, while automatic safety brakes and hand-operating gear are fitted. The new bridge comes perhaps too late to influence the development of the Cart as a shipbuilding river in any marked degree, but it certainly removes the size restrictions which were formerly imposed on Cart shipbuilders, and they and the Corporation of Paisley are to be congratulated on the success of the scheme upon which they embarked nearly two years ago.

### The Ruhr.

From a purely industrial point of view it must be admitted that the occupation of the Ruhr has proved an expensive operation, for it deprived the Lorraine blast-furnaces of coke, of which the supplies had nevertheless been dwindling, and it created an inflation of prices, due to a famine in raw material, which involved the country in a temporary heavy loss. The fear that nothing would come out of the occupation except trouble has nevertheless been modified by the tangible results obtained during the month in the way of supplies of coal and coke. To secure them a technical and military organisation carried out under great difficulties has been needed; but despite the passive resistance offered to the French action in the Ruhr, consignments of coal and coke are now being sent regularly to France, Belgium and other countries. As the consignments are steadily increasing, the French believe that in a very short time the situation will become normal, and the iron and steel production will be again active. Even the future attitude of the German Government is regarded as of little moment, for so long as the Ruhr can be exploited, the French declare that they can afford to wait, and will wait, indeed, indefinitely. At the same time it must not be overlooked that they have been drawing upon heavy accumulations of stocks for their supplies of coal and coke, and when those stocks are exhausted there will be nothing more forthcoming, unless the Germans can be induced to work, for there can be no question of replacing the three quarter of a million men employed in the Ruhr. In their effort to solve this novel and extremely complicated industrial problem the French have so far the upper hand, for if they are obtaining little for the heavy sacrifices they are making, the Germans themselves are losing everything. The question now resolves itself into whether the Germans will not soon deem it prudent to cut their loss.

### Railway Signalling that Gives False Security.

On the 17th a report by Major Hall was issued as to a collision on January 6th at New Cross Station on the Brighton section of the Southern Railway. This document is of interest inasmuch as it shows how signalmen rely on apparatus provided as a substitute for direct observation of the condition of the roads they have to look after and for their own memory. The report in question shows, however, more than this; it reveals that this particular apparatus was installed about thirty years ago and that it has been altered and rearranged considerably since it was first put in. One respect in which the signalling was deficient was that there was a series of depression fouling bars along the East London line, but there were gaps, 90ft. in length, between the bars, and there was a space of 82ft. between the starting signal and the bar nearest to it. These bars, when depressed by the presence of a vehicle, locked the arrival signal; but this obviously was not done when, as in this case, an engine and van were at rest in one of the spaces. Had complete interlocking been in force the fact that the signalman at the Yard box irregularly "cleared" the engine and van and "accepted" a Metropolitan passenger train would not have led to an accident, as he could not have lowered his signal for the latter as long as the engine and van were there. Track circuiting would remedy this defect, and Major Hall makes a recommendation accordingly. Then the indications given by the block instruments do not accord with the signals sent and received, and one consequence of this is that "a signalman is placed in the position of having to signal an oncoming train into a section which his block instrument shows to be occupied by a movement in the opposite direction." What strikes us as strange is Major Hall's remark that "As now arranged, neither the type of instrument nor the circuits are such as would either have been installed by the manufacturers originally, or supplied at the present time, for the purpose for which they are used." This remark suggests that the company has made some modification in the apparatus supplied by manufacturers of which the latter would not approve—a situation that would be very unsatisfactory to the makers.

### Warrington's Water Bill.

There was much wordy warfare in Parliament when Warrington's Bill, by which it is sought to obtain an additional supply of water from the Ceiriog Valley, came up for second reading in the middle of the month. Warrington, it may be explained, is desirous of building two dams in the valley, so as to impound the water of the river Ceiriog. It was urged in support of the Bill that Warrington at present obtained its water from wells which were gradually drying up, so that the supply was only just equal to the demand. It was argued, furthermore, that it was the nearest source from which the town could obtain additional supplies, though it was 50 miles away, and the question was asked by Captain Reid, Member for Warrington, who stated the case for the Bill, whether any sane community would go as far afield as that if it could get what it wanted nearer home? Opposition, as was natural, came from Welsh Members, Mr. Lloyd George making an eloquent appeal to Members to throw out the Bill and prevent interference with one of the most beautiful valleys in Wales, a spot, too, the name of which was so intimately connected with that of one of the nation's most revered poets. As against that, Captain Reid maintained that only 386 acres, instead of over 13,000, as had been alleged by one of the opposers of the Bill, would be submerged; that the lake formed would probably add to the beauty of the scenery; and that no building of historic interest would be touched, the nearest being three-quarters

of a mile away. There had, too, been an assertion that the site of a famous battlefield would be submerged, but Captain Reid was able to refute it by proving that the battlefield in question was no less than nine miles away from where it is sought to form the reservoirs. As a result of the debate, an amendment to refer the Bill to a Committee with special powers was negatived by 276 votes to 91, and the Bill was read a second time.

## Tariffs and Trade.

The introduction of a Bill by the Government of Belgium during the month for raising considerably the import duties of foreign goods is a characteristic example of the policy of retaliation which is being forced upon some countries by the commercial exactions of others. Having always adopted liberal trade principles, Belgium found herself placed at a great disadvantage in the negotiations being carried out with France for a commercial treaty. The object of the separate treaties formulated by the French Government is to secure special advantages for the many new industries that have been created during the past few years, particularly in the way of opening up markets in countries which are offered reciprocity in favour of goods that do not compete seriously with French products, and when industrial interests clash, as is the case with Belgium, there is obviously no way out of the difficulty except by a change of fiscal policy which will enable Belgium to offer reciprocal advantages. As a matter of fact, Belgium aims at treating with France on the basis of facilitating imports of essentially French goods in exchange for lower tariffs on Belgian manufactures entering France. For that reason the proposed Belgian duties will be a serious burden upon the essentially French products which bulk so largely in foreign trade, unless the French Government accepts an arrangement whereby foreign engineering goods are allowed to enter the country under favourable tariff conditions. The negotiations have shown the French Government that it is practically impossible to develop a foreign trade and at the same time adopt a rigid policy of protection for certain branches of the engineering trades which cannot exist in face of foreign competition. For the time being those industries are favoured to a certain extent by the currency depreciation; but the advantage is only temporary, and the considerable changes that may take place in the future will certainly upset any commercial arrangement which aims at conferring one-sided benefits. The progress of negotiations between France and Belgium will show whether it is possible in present circumstances to fix upon a reciprocal basis for commercial treaties.

## The Vindication of the Therm.

As everyone who had any real knowledge of the matter imagined would be the case, the Departmental Committee appointed by the Board of Trade to inquire into the therm basis of charging for gas declared itself to be in favour of that much-maligned unit. In fact, it not only recommended, in a report published during the month, that the therm system should be continued, but suggested that it should be extended to all statutory gas undertakings within the scope of the Gas Regulation Act. The inquiry certainly did good, in that irresponsible and ignorant critics are no longer able to accuse gas authorities of unfair dealing with their customers, and it seems not unlikely that to it the recent reductions in the price of gas may be, indirectly, attributed. Suppliers of gas have been reviewing their charges, with the result that there have been reductions in various directions, to the benefit not only of the consumers, but of the shareholders as well, who have been faring unhappily during the period of high charges which have automatically resulted in reduced dividends, for, as our readers are aware, the dividends of gas undertakings vary inversely with the price of the gas. Dr. Charles Carpenter, the president of the South Metropolitan Gas Company, recently stated at a meeting of shareholders that there was nothing wrong about the therm, but that there had been with the price charged for it. If the suppliers have been tardy in reducing the price, the shareholders have had more cause to complain than the consumers, for they have been doubly taxed. They have not only had to pay a high price for the gas they have burned, but have received smaller returns from their investments. It is only just recently that the dividends of gas companies have begun to approach pre-war figures, but hopes are felt in many quarters that, before very long, the price of the therm may be so far reduced that gas may become as cheap as it was nine years ago.

## The Stadium in Wembley Park.

The Stadium which is being built in Wembley Park in connection with the British Empire Exhibition of next year, is nearly completed, its erection having been specially expedited in order that the structure may be available for the Football Cup Ties Final on April 28th. The photograph taken from an aeroplane, which is reproduced in Fig. 1, hardly gives an adequate idea of its size, for it is a large and imposing building, which has been designed to provide, under cover, sitting accommodation for 25,000 persons, in ring seats for 10,000 persons, and standing room for an additional 91,500, so that it is capable of holding no fewer than 126,500 people, all of whom will have a practically uninterrupted view of the whole of the arena. A plan of the building is given in Fig. 2. The arena itself, which is intended for both sports and games, has in its centre an absolutely level round-ended oblong of grass which measures 492ft. long—for some 375ft. of which the sides are parallel—and 260ft. wide. In passing, we may say that we understand the ground on which the Final Cup Tie is to be played will measure 115 yards—or 345ft.—long by 75 yards—or 225ft.—wide, so that the area provided is more than ample for the purpose, as was, of course, intended that it should be. We may here remark too—though it has nothing whatever to do with engineering—that the grass, the turves of which were obtained in various portions of the estate, and were laid as long ago as September last, is really in excellent condition. Encircling the grass is a flat and level cinder running track, about half of which is 42ft. wide, the remainder being 18ft. wide. The dimensions are such that a line drawn at a distance of 1ft. from the edge of the track right round the oblong measures exactly one quarter of a mile in length, so that four laps constitute a mile. A feature, to which we shall refer in more detail later, is that, by making special arrangements, in accordance with a decision arrived at after the building operations had been actually started, a perfectly straight and level track, 220 yards—*i.e.* just over 200 m.—long, has been provided, and it is, we believe, the only straight cinder track of that length in this country.

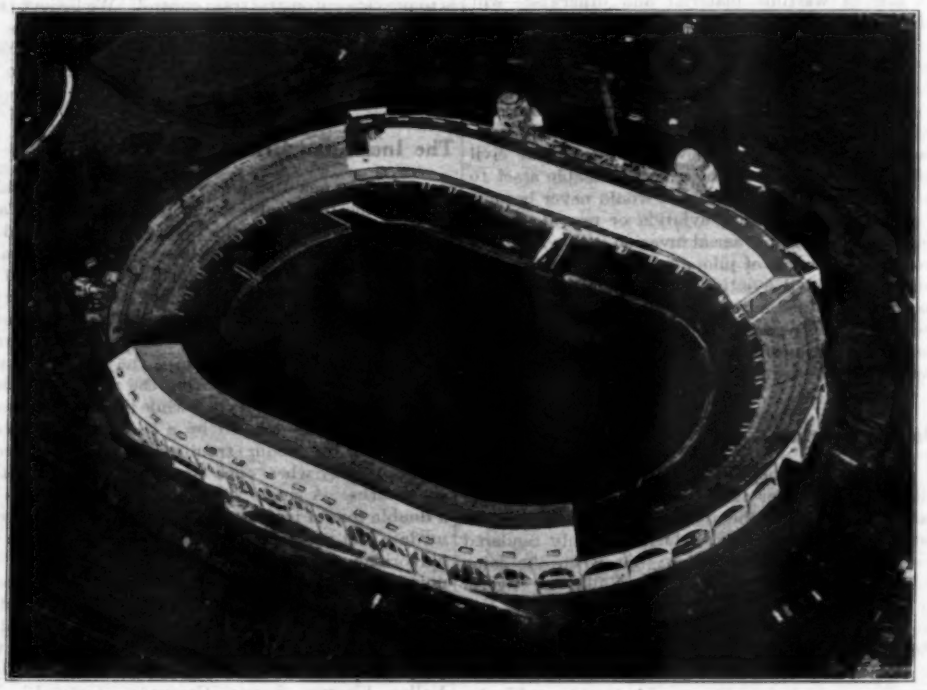


FIG. 1—VIEW OF THE WEMBLEY STADIUM FROM THE AIR

Immediately encircling the running track, a strip of ground just over 11ft. wide, which is enclosed both in front and behind by an iron ring fence, is to be devoted to five rows of "special ring seats" arranged at three levels, and supported on blocks of concrete. We understand that, when the arena is not being used for racing pruposes, seats of various heights will also be placed, temporarily, over a certain width of the running track itself, so that, at times, there may be as many as ten rows deep of these "special ring seats." For a width of nearly 56ft. 6in. right round the inner fence of the ring seats enclosure, tiers of forty-eight steps are formed, the steps being just over 1ft. 2in. wide, the risers varying from 3½in. in the lower rows to 4½in. in the upper rows, and being formed by means of 5in. by 2in. timbers set on edge. This oval annulus—if such an expression be permitted—will be for standing spectators only, and there will be no cover. For obtaining access to these terraces of steps there are forty-nine openings formed in the wall enclosing them and nine radial gangways. Access is also possible by way of the main tunnel which leads directly into the arena, and to which reference will be made later; but whether or not that will be permitted we cannot say. The difference in vertical height between the lowest and the highest steps is just over 16ft. 6in. In order, apparently, to prevent rushes from the top to bottom of these terraces of steps, and of compelling the use of the gangways, three rows of barriers have been formed between each of the latter. Their arrangement will be seen in Figs. 10 and 13, page 368. They consist of steel pipes fixed horizontally at a height of about 4ft. above step level and carried at their ends and at intervals in their length by angle iron brackets of inverted V shape. The steps, the treads of which are filled in with coarse clinker at the bottom and a topping of 1½in. of fine cinders, have in some parts been formed directly on solid ground, the soil being given the necessary slope; but where the original contours of the land did not permit of that being done—and that was the case in the major portion—filling-in had to be resorted to. Although in selecting the site for the Stadium advantage was taken as much as possible of favourable contour lines, a very considerable amount of excavation had to be carried out. In fact, for one purpose and another, as many as 120,000 cubic yards of material—mostly yellow clay—had to be removed, and an equal amount used in filling. As will be seen from the plan given in Fig. 2, the original ground level of the arena site varied between 165.5ft. above Ordnance Datum at the east end to something over 180ft. above Ordnance Datum at the west end, with intervening eminences above the average between these two figures coming in between. The excavation was, to a large extent, done by a Bucyrus drag-line excavator. We may here say that the clearing of the site was started in February, 1922, and that the work is now complete. The actual building operations, which are now virtually finished, occupied less than a year.

It is around the outermost of the terraces of steps referred to above that the building proper of the Stadium may be said to commence. All round the building there is a practically uninterrupted series of thirty-one terraces of concrete steps measuring 2ft. 2in. wide and having rises of 1ft. 1in. These steps are formed in the manner shown in the drawing, Fig. 6, and in Figs. 3 and 4. They are erected on bearers consisting of 14in. by 6in. by 46 lb. and 57 lb. rolled steel joists spaced generally at 14ft. 4in. centres. The joists, which are set at a slope of 2 to 1 with the horizontal, are supported at their lower extremities by being attached to the reinforced concrete wall which stands on a solid concrete foundation, and is built round the outside periphery of the ramp of steps first mentioned—see Fig. 5. At their upper ends they are supported by the outside wall of the Stadium, which will be referred to later. These joists are at three points in their length connected together by lattice girders to which they are riveted, and every third joist is supported at the junctions of the joists with the girders by steel columns of increasing heights. These columns—see Figs. 5 and 6—are made of steel channels and lacing bars, and they are spaced radially at 17ft. 4in. centres. The tallest of these columns is 32ft. high and the shortest 16ft. high. In the shortest there are two 9in. by 3in. channels; in the intermediate two 10in. by 3½in. channels; and in the tallest two 11in. by 3½in. channels, the lacing bars in all cases being 2½in. by $^5/_{16}$in. These columns are erected on solid concrete foundations taken well down into virgin ground. It may here be stated that the tops

of these foundations came just above the floor of a concrete corridor which stands at a level of 174.75 above Ordnance Datum. This corridor, which runs at the same level practically all round the Stadium, will be referred to later. The two outer rows of columns are braced together, and the outermost row is braced to the outer wall in the manner shown in the engravings. The risers of the steps are formed of pre-cast reinforced concrete beams 14ft. 3in. long high, and 13in. by 13in. in cross section for the major portion of their length, but increased in dimensions at the top and bottom. There are sixteen of these supporting columns on the south side of the arena all spaced at equal distances apart—*i.e.*, 43ft. On the other side of the arena there are only twelve columns for the same length of roof. For the five columns at each end of the row the spacing is the same in each case, but the spacing between the two centre columns is as much as 130ft., and that between each of them and the next column outwards is 86ft. The wide spacing between the two centre columns has been provided so that there might be no interference with either the structure or the view from the Royal box or balcony which comes exactly in the centre of the north side of the building. The wider spacing of the columns at this point also has the effect of improving the view of the arena from the Press gallery, which, so that the roof actually projects for some 20ft. beyond the line of the columns. The arrangements are well illustrated in the various engravings—see Figs. 5, 6 and 7 and in Figs. 10, 12 and 13, page 368—and call for no further comment.

The method of supporting the joists for the concrete steps on the north side of the arena, that is to say, where the block of buildings comes, is shown in Fig. 8. It is different from that employed in other

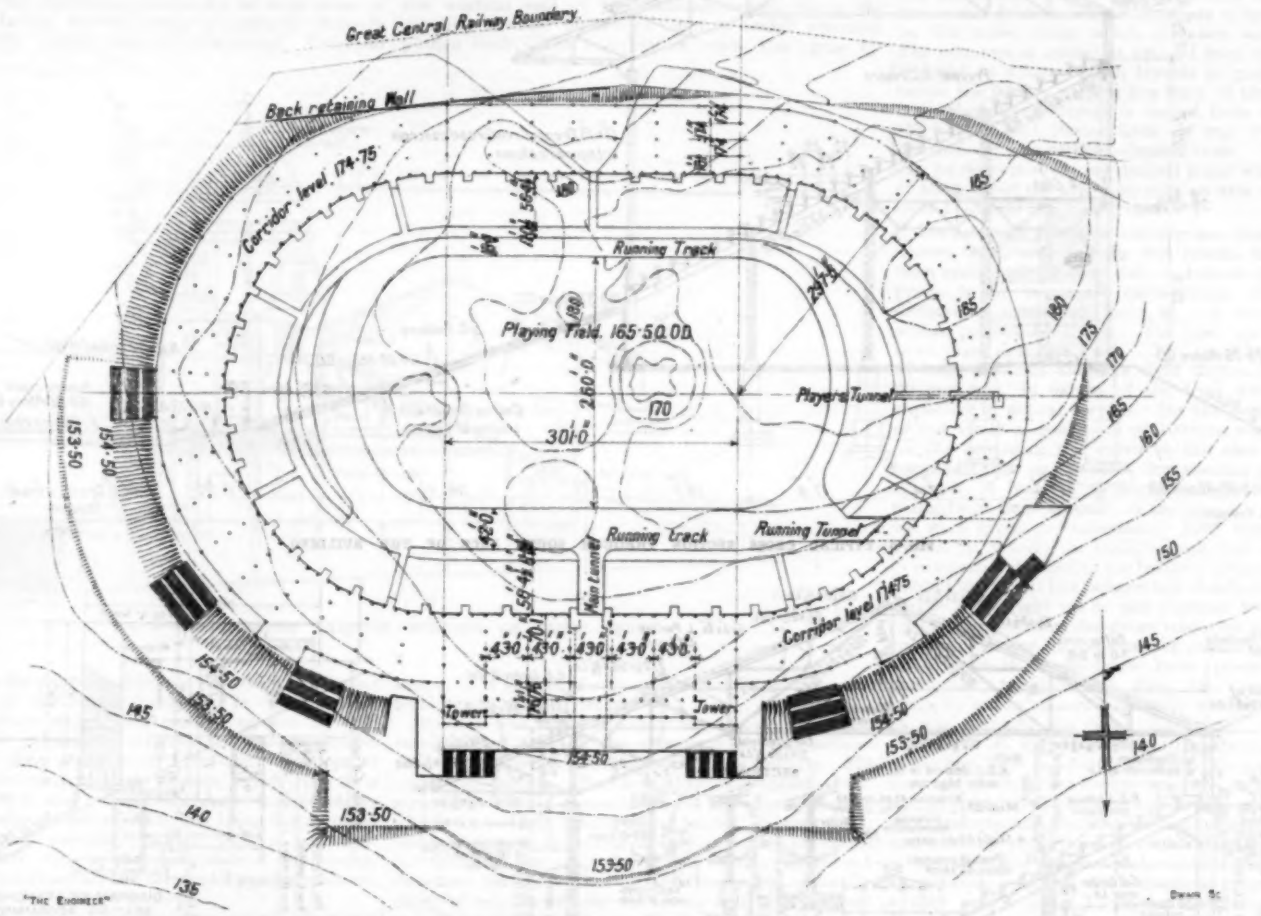



FIG. 2—GENERAL PLAN OF THE STADIUM SHOWING THE ORIGINAL CONTOUR LINES OF THE SITE

by 4½in. wide and 1ft. 4½in. deep, set on edge. The ends of these beams rest on specially shaped pressed steel knee pieces of the steel joists—see Fig. 6. No less than 5000 of these beams were required. The treads of the steps are formed of reinforced concrete 1½in. thick and were cast *in situ*—see Fig. 4.

For a length of 650ft. on each side of the Stadium these steps are roofed in and it is the roofed-in portions which will provide sitting accommodation. The steps

FIG. 3—VIEW SHOWING ERECTION OF TERRACES OF CONCRETE STEPS

FIG. 4—CONCRETING TREADS OF TERRACED STEPS

situated in the centre portions of the covered areas have been furnished with lift-up wood seats each 16in. wide. In the wing portions of the covered area sitting accommodation is provided by means of planed wood planks fastened to the concrete treads. The roofs have steel framework, covered with corrugated asbestos sheets. The principals are supported partly by the outside wall and partly by means of pre-cast octagonal reinforced concrete columns 32ft. as will be seen from Fig. 8, comes immediately behind, but at a considerably higher level than the Royal box. The three columns where the wider spacing comes are stouter than the other columns, and measure 15in. by 15in. in cross section. They are, however, otherwise identical with the others. Resting on the caps of the columns, and tying them together, are steel lattice girders, and worked into these girders are the roof principals, which are extended, cantilever wise, room stands at an elevation of 174.75ft. above Ordnance Datum, that is to say, at the same level as the corridor, mentioned above, which runs right round the building. Immediately over the hall and at a height of 25ft. above it is a tea room, which is also a large room that will be able to accommodate 600 people at a time.

The Royal box or balcony, the floor of which stands at a height of about 21ft. above the grass in the arena,

# THE STADIUM IN WEMBLEY PARK

MESSRS. JOHN W. SIMPSON AND MAXWELL AYRTON, ARCHITECTS, AND MR. E. O. WILLIAMS, ENGINEER

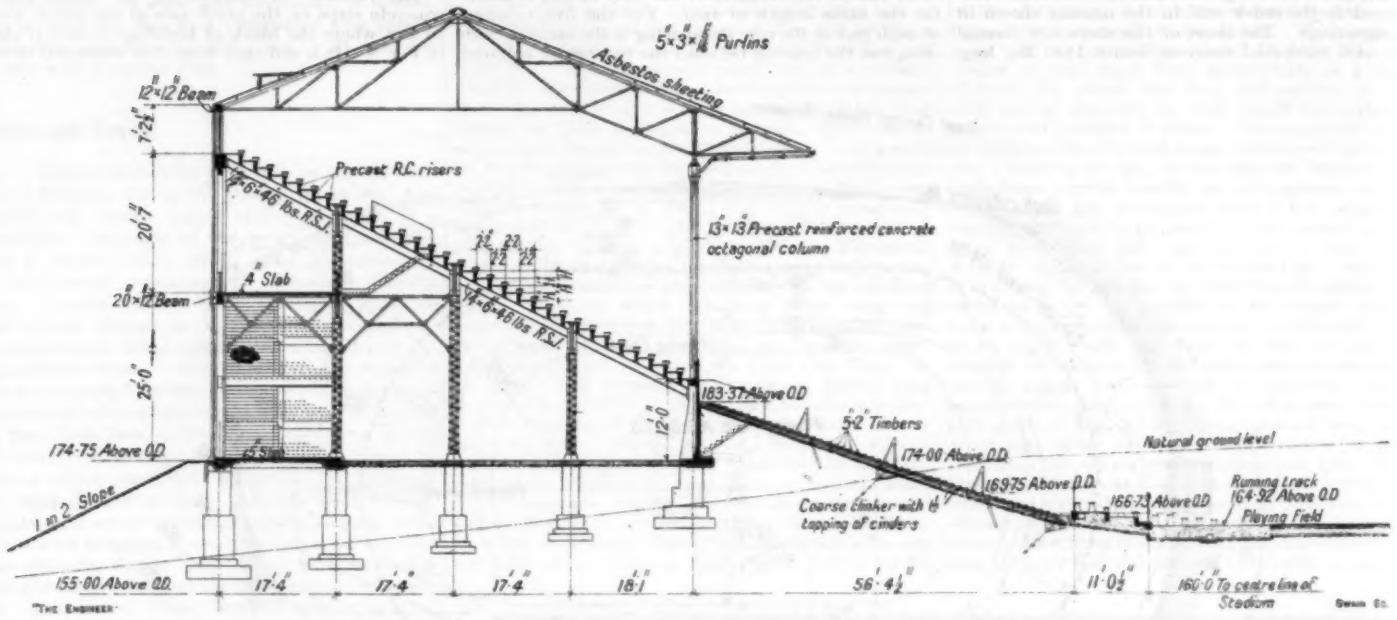



FIG. 5—TYPICAL CROSS SECTION THROUGH SOUTH FACE OF THE BUILDING

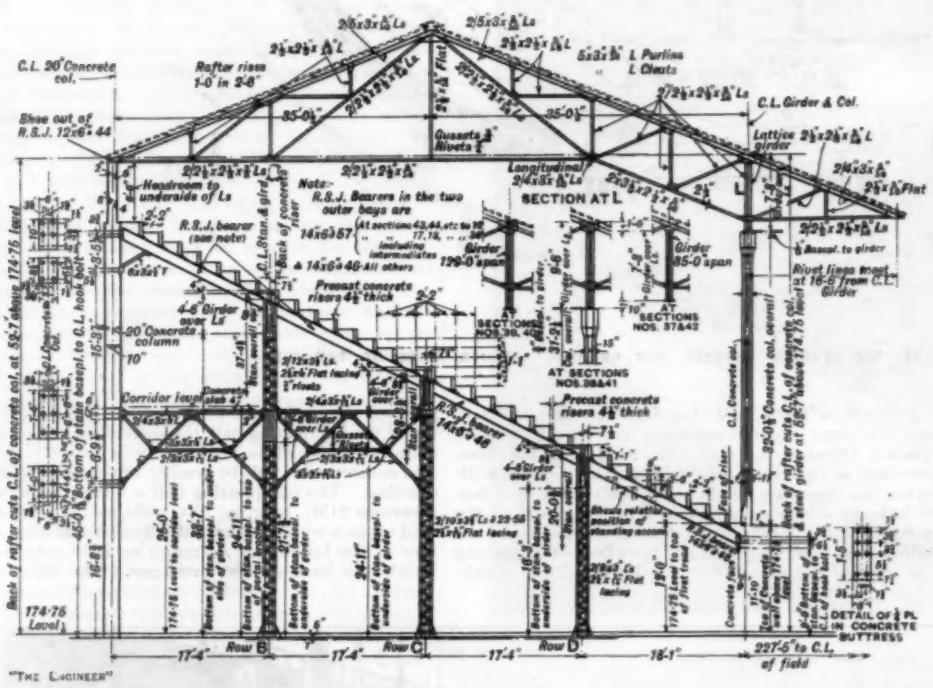

C.L. 20" Concrete col.
Rafter rises 1-0" in 2-6"
Shoe out of R.S.J. 12"×6"×44
35'-0½"
Quarter Rivets
C.L. Girder & Col.
Lattice Girder
SECTION AT L
Headroom to underside of Ls
R.S.J. bearer (see note)
Note:- R.S.J. Bearers in the two outer bays are 14×6×67 (At sections 43,44, etc to 56 ... including intermediates) & 14×6×46 All others
Precast concrete risers 4½" thick
4·6" Girder over Ls
90" Concrete column
Corridor level
Girder 129'-0" span
Girder 85-0 span
AT SECTIONS NOS. 38 & 41
AT SECTIONS NOS. 37 & 42
Precast concrete risers 4½" thick
Riveted to girder
Rivet lines spaced at 16-0 from C.L. Girder
DETAIL OF ½ PL. IN CONCRETE BUTTRESS
174·75 Level
77'-4" Row B
77'-4" Row C
77'-4" Row D
18'-1"
227'-6" to C.L. of field
"THE ENGINEER"
Top of tread
Girder Ls
Girder 4'-6" over Ls
Top of 14×6" R.S.J. bearer
DIAGRAM OF STANCHION HEAD SEATING ACCOMMODATION
C.L. of stan. & girder
C.L. Stan to face of chair
DIAGRAM OF STANCHION HEAD STANDING ACCOMMODATION
SWAIN SC

FIG. 6—ARRANGEMENT OF ROOF, TIERS OF STEPS, AND STEEL WORK

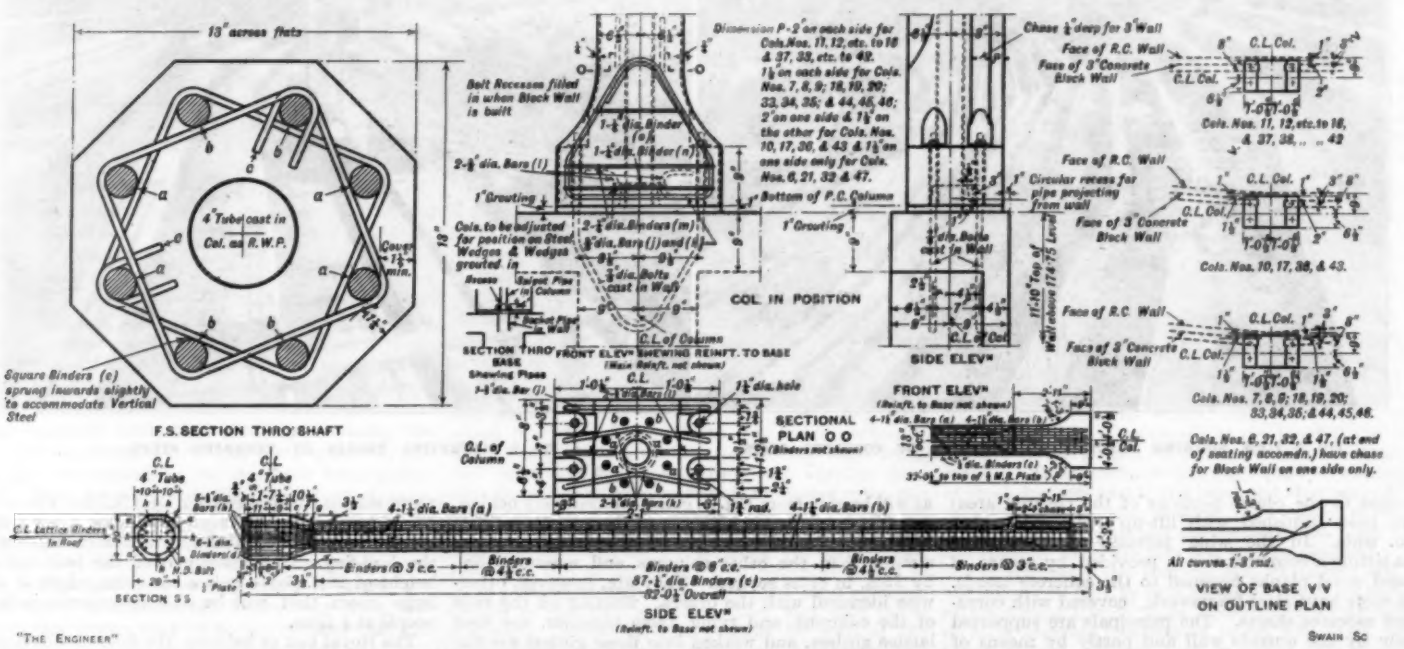

13" across flats
4" Tube cast in Col. as R.W.P.
Square Binders (e) sprung inwards slightly to accommodate Vertical Steel
F.S. SECTION THRO' SHAFT
Bolt Recesses filled in when Block Wall is built
1-½" dia. Binder (n)
1-½" dia. Binder (m)
2-⅝" dia. Bars (l)
1" Grouting
Cols. to be adjusted for position on Steel Wedges & Wedges grouted in
2-½" dia. Binders (m)
⅝" dia. Bars (j) and (k)
¾" dia. Bolts cast in Wall
Bronze Swivel Pipe in Column
Facing of Wall
C.L. of Column
SECTION THRO' BASE Showing Pipes
FRONT ELEVN SHEWING REINFT. TO BASE (Main Reinft. not shown)
Dimension P-2" on each side for Cols. Nos. 11, 12, etc. to 18 & 37, 38, etc. to 42. 1½ on each side for Cols. Nos. 7, 8, 9; 18, 19, 20; 33, 34, 35; & 44, 45, 46; 2" on one side & 1½" on the other for Cols. Nos. 10, 17, 36, & 43 & 1½" on one side only for Cols. Nos. 6, 21, 32 & 47.
Bottom of P.C. Column
1" Grouting
COL IN POSITION
SIDE ELEVN
Chase ½" deep for 3" Wall
Face of R.C. Wall
Face of 3" Concrete Block Wall
C.L. Col.
Cols. Nos. 11, 12, etc. to 18, & 37, 38, .. .. 42
1" Circular recess for pipe projecting from wall
Cols. Nos. 10, 17, 36, & 43.
Cols. Nos. 7, 8, 9; 18, 19, 20; 33, 34, 35; & 44, 45, 46.
Cols. Nos. 6, 21, 32, & 47, (at end of seating accomdn.) have chase for Block Wall on one side only.
SECTIONAL PLAN O O (Binders not shown)
1½" dia. hole
1½" rad.
4-1½" dia. Bars (a)
4-1½" dia. Bars (b)
2-¾" dia. Bars (h)
FRONT ELEVN (Reinft. to Base not shown)
4-1⅝" dia. Bars (a) 4-1⅝" dia. Bars (b)
⅝" dia. Binders (c)
32'-0½" to top of ½ M.B. Plate
SECTION S S
C.L. Lattice Binders in Roof
4" Tube
4-⅝" dia. Bars (h)
⅝" dia. Binders (d)
H.D. Bolt
1" Plate
Binders @ 3" c.c.
Binders @ 4½" c.c.
Binders @ 6" c.c.
87-1½" dia. Binders (c)
62-0½" Overall
SIDE ELEVN (Reinft. to Base not shown)
All curves 1-3" rad.
VIEW OF BASE V V ON OUTLINE PLAN
"THE ENGINEER"
SWAIN SC

FIG. 7—DETAILS OF REINFORCED CONCRETE ROOF-SUPPORTING COLUMNS

is approached by means of five flights, having a total of forty-seven steps, from a tunnel formed from the north face right under the main building and giving access at the other end to the arena. This tunnel, which is 40ft. wide, varies in height from 20ft. at the entrance to 13ft. at the exit, has a concrete arch at either end.

The whole building is constructed of concrete on a steel skeleton. A noteworthy feature is that fluted shuttering has been employed with excellent effect, the somewhat distressing monotony of large areas of concrete facing having been practically entirely avoided, the employment of horizontal V-shaped

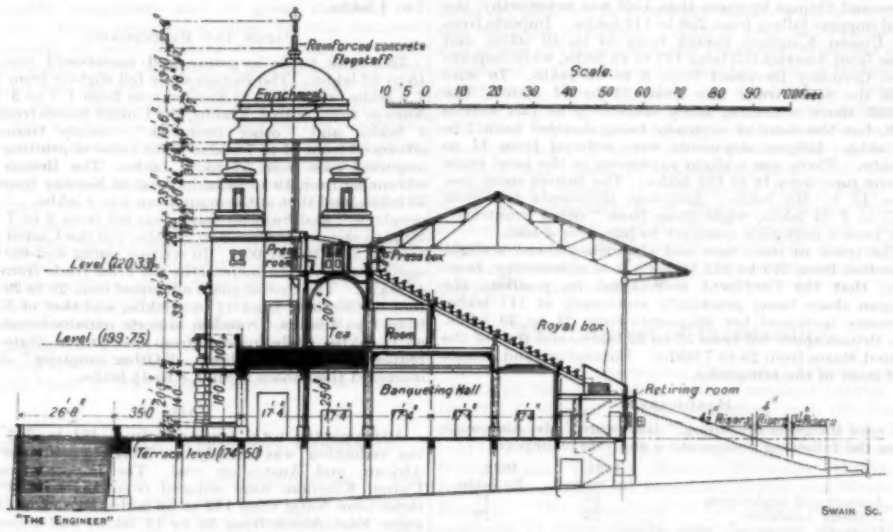



FIG. 8—CROSS SECTION THROUGH BUILDING ON NORTH FRONT

channels in the material aiding in the effect. Another advantage of the fluted shuttering is that the disfiguring marks which are usually caused by the divisions in ordinary shuttering have been almost completely done away with. Imposing features of the front are two concrete towers which rise to a height of 106ft. 4in. above the terrace, and reach to over 280ft. above Ordnance Datum, being surmounted by a reinforced concrete flagstaff rising to a further height of 22ft. 6in. to the underside of the trucks, which are fashioned in the form of Imperial crowns, and are also of reinforced concrete.

The outside wall of the Stadium, saving where the building on the north face—just described—comes, is formed of a series of nearly semi-circular arches carried on vertical piers. The piers arise to a height of 25ft. above the corridor, and the height to the crown of the arches is another 20ft. 6in. The arches vary slightly in span according to their positions and to the amount of curvature of the outside face of the wall at the points where they occur. The average span is, however, about 50ft. Both piers and arch ribs are of reinforced concrete cast *in situ*. Expansion joints are provided at intervals of four arches, and where they come the break is made at the centre of the crown of the arch. In such cases, of course, the two halves of the arch are cast separately and act as cantilevers. In a majority of cases the arches are simple, but, where extra loads from roof have to be taken, a 20in. by 12in. reinforced beam is arranged on the tops of the piers at springing level. In such cases two equally spaced spandrel posts connect the top of the beam with the soffit of the arch. Expansion joints are also formed in these beams where the joints in the arches come. The dimensions of the piers vary with the weight they have to carry, but the cross section of the majority is 3ft. by 1ft. 8in. They are erected on solid foundations with wide stepped footings taken well down into virgin soil. Only at one place has a retaining wall been formed, and that is at the south-east end, where the building approaches most nearly to the Great Central line, which at that point is in a somewhat deep cutting. This wall, as well as the railway line, can be seen in the view from the air given in Fig. 1. Above the crown of the arch the wall is taken up for another 7ft. 2½in. by means of pre-cast concrete blocks and a surmounting reinforced concrete beam 12ft. by 12in., and it is to the latter that the roof principals are attached. The top of the wall therefore reaches a height of 52ft. 9½in. above the level of the corridor or 227ft. 6½in. above Ordnance Datum.

The level of the corridor is, as has been said, 174.75 above Ordnance Datum, or at 9.83ft. above the running track which stands at 164.92 above Ordnance Datum. Access to the corridor from the outside is obtained by means of five separate flights of reinforced concrete steps, while the terrace on the north front, which is practically at the same level as the corridor, is reached by means of two sets of forty reinforced concrete steps which are about 25ft. wide. It is from the corridor that all parts of the Stadium are approached. First of all there are round the periphery of the inner ramp of standing places the forty-nine concrete openings formed in the dwarf wall, which are reached by flights of ten steps up from the corridor level. Then at an elevation of 25ft. above the corridor is a gallery with a reinforced concrete floor, about 16ft. wide, which runs from end to end of the south portion of the building which is roofed over. It is reached by a series of double stairways of reinforced concrete, which are built at intervals of 150ft. From that corridor flights of ten steps lead up to openings formed at intervals of 50ft. in the tiers of concrete steps.

The quarters assigned to the competitors are at the western end of the Stadium, where there are dressing rooms, lavatories, and a small concrete plunge bath. The competitors reach the arena by means of a tunnel, the floor of which is at the same level as the running track.

Mention was made above of the tunnel which has been formed through the structure of the Stadium in order to provide a straight track one furlong—220 yards—in length. The flexibility of concrete construction is well exemplified in the arrangements which have been made. The tunnel is some 24ft. wide, and since it was necessary to make provision for carrying not only the weight of the superposed structure but also that of the spectators, specially designed reinforced concrete beams had to be worked in. These beams measure 3ft. by 2ft. and they are connected together by means of cross beams which carry the floor of the corridor. The length of the tunnel is nearly 150ft., and for that part of the distance the competitors will, in consequence, run under cover. Perhaps at this point a word as to the excellence of the cinder track throughout may not be out of place.

As giving some idea of the immense size of the undertaking, we may say that the overall length of the Stadium on its major axis is 900ft., and that the maximum overall width is 650ft. The following is a list of the quantities of the various materials used:—1400 tons of structural steel work; half a million rivets, for which one and a-half million holes had to be drilled; 600 tons of steel rods for reinforcing the concrete (total length of these rods is about 500 miles, and the total numbers of the rods one-quarter of a million); 25,000 tons of concrete, using 3500 tons of Portland cement; 14 miles of concrete beams to form the terracing in the stands.

The concrete in the north or main front has been and still is being placed by means of an "Insley" tower. The tower is of light steel work and is 160ft. high, and may be seen in Fig. 9 and in Fig. 11, page 368. It carries a long movable jib from the end of which is suspended a balanced truss which can be turned in any direction. There is a hopper near the top of the tower and from it leads a chute to a further hopper on the truss, along which is taken another chute. The concrete is mixed at ground level in a machine, is lifted in a box, which travels in guides arranged inside the tower. When the level of the top hopper is reached the concrete is tipped from the box into the hopper and thence finds its way by gravity to the delivery end of the balanced truss. The material can be deposited at any desired point within a radius of 400ft. from the tower, so that an area of something over 11½ acres can be covered

We may say that the building has undergone some severe tests, and though the results have not yet been completely worked out, we believe that they will prove to be eminently satisfactory. Some of the deflections measured, have, at any rate, been well within permissible limits. The tests were made with both dead and live loads. The dead load consisted of bags of sand and the load imposed was about 60 per cent. in excess of the load which is to be expected in actual service. On the occasion of one of our visits a dead load of 300 tons was in position on the centre of the curve at the east end. It so happened that on the same day the live load test was applied. A body of workmen released for the time being from their labours on the site, and numbering, we were given to understand, 1280, was first of all drawn up outside the building and then marched in, in companies, and led to the banks of seats immediately behind the Royal box, where they closely filled a section of the seats right up to the topmost level. It was quite obvious that the great majority of these men had seen service in the war, for otherwise we do not think that it would have been possible, without preliminary drill—which they had not had—for them to act in unison with such wonderful precision as was actually the case. Under the command of Captain F. B. Ellison, who, during the course of the work, has been resident architect, the men were put through a series of movements, such as standing up, sitting down, swaying from side to side and backwards and forwards, and marking time, all of which had to be, and actually were, done to time. The men appeared to the onlooker to be wonderfully together in their movements, and the whole business must have been a very useful test. Then the instructions were to shout and jump about and wave the arms frantically so as to reproduce as nearly as possible the movements of a crowd watching an exciting match. Afterwards the test was repeated on the other side of the Stadium

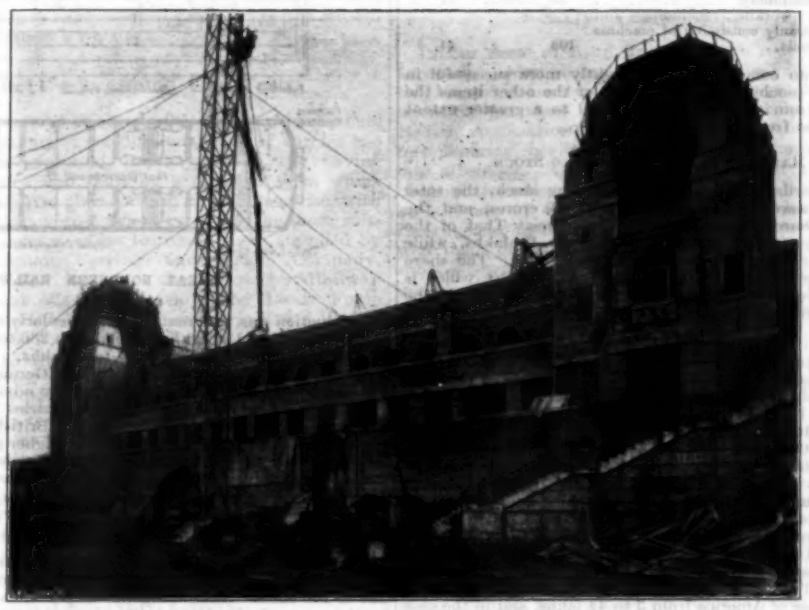


FIG. 9—BUILDING ON NORTH FRONT UNDER CONSTRUCTION

at a point not quite opposite the Royal box; just outside the eastern end of the covered area, in fact. Then the men were marched along the steps until they came beside the portion which was loaded with dead weight. There, further movements were gone through, including marking time at the double—an experience which the structure is never likely to have to undergo when fulfilling its usual functions. Finally gangs of the men were ordered to run down several flights of the steps. In every case, as was, of course, anticipated, the test was without visible result, there being no sign of weakness.

The architects of the building are Messrs. John

W. Simpson, P.P.R.I.B.A., and Maxwell Ayrton, F.R.I.B.A., and the Consulting Engineer is Mr. E. O. Williams, A.M. Inst. C.E., to whom we are indebted for a large proportion of the information contained in the foregoing. The quantity surveyors are Messrs. Baker and Mallet, the contractors Sir Robert McAlpine and Sons, with Edward Wood and Co., Ltd., of Manchester, as sub-contractors for the steel work, and the resident engineering inspector, Mr. J. Underwood.

## Import Trade of India During Period April—December, 1922.

Several interesting facts are brought out in a report which has recently been made by the British Senior Trade Commissioner in India (Mr. T. M. Ainscough) to the Department of Overseas Trade on the import trade of that country during the period from April to December last year.

It appears that the total imports of merchandise for the nine months declined from 197 crores of rupees in 1921 to 173 crores in the corresponding period of 1922. The shipments from the United Kingdom declined from 111 to 106 crores, but it is satisfactory to note that the British share of the total rose from 56 to 61 per cent., as contrasted with a reduction of the share of the United States from 9 to 6 per cent. A striking feature was the increase in the proportion of goods derived from Germany, from 2.4 to 5 per cent. Imports from Japan also increased slightly from 5 to 6 per cent.

### Machinery and Millwork.

After discussing the import values of cotton yarns, piecegoods (unbleached and bleached), piecegoods (coloured, printed or dyed), sewing cotton, haberdashery, &c. &c., the Commissioner turns to machinery and millwork. and remarks that in view of the acute trade depression and the difficulties that many industrial concerns, which were floated during the boom period of 1919–20, are encountering, it is not surprising that the total imports for the nine months—17.86 crores—showed a heavy fall as compared with the corresponding period of last year—25.44 crores. It is satisfactory, however, he points out, that the reduction in the case of the imports from the United Kingdom was less than that of our principal competitors. British shipments fell from 20.79 to 15.07 crores, and American from 3.76 to 1.77 crores ; but, on the other hand, imports from Germany advanced from 39 to 59 lakhs, and those from Switzerland from 3 to 9 lakhs. The total imports under the various classifications of machinery were as follows :—

| | 1921. Rs. lakhs. | 1922. Rs. lakhs. |
|---|---|---|
| Cotton machinery | 493 | 620 |
| Jute machinery | 344 | 135 |
| Electrical machinery | 275 | 254 |
| Boilers | 101 | 101 |
| Mining machinery | 59 | 25 |
| Oil-crushing and refining machinery | 39 | 8 |
| Paper mill machinery | 27 | 6 |
| Refrigerating machinery | 11 | 6 |
| Rice and flour mill machinery | 51 | 33 |
| Sawmill and woodworking machinery | 23 | 7 |
| Sewing and knitting machines | 16 | 40 |
| Sugar machinery | 74 | 16 |
| Tea machinery | 15 | 17 |
| Metal working, including and mainly consisting of machine tools | 103 | 44 |

American competition was slightly more successful in electrical machinery, but in most of the other items the imports from the United States fell to a greater extent than those from the United Kingdom.

### Railway Plant and Rolling Stock.

As regards railway plant and rolling stock, the total imports were reduced from 14¼ to 9¼ crores, and the British share fell from 14 to 8.69 crores. That of the United States remained stationary at 12 lakhs, while Australian imports fell from 15 to 8 lakhs. The share of "other countries" rose from 8 to 30 lakhs, which is to be accounted for by increased purchases from the Continent.

### Iron and Steel.

The total trade in iron bars and channels advanced from 28 to 35 lakhs. The British share fell from 18 to 13 lakhs, while Belgium more than doubled her shipments from 8 to over 16 lakhs. There was a considerable increase from Sweden (Rs. 85,000 to 3 lakhs), and from "other countries" (Rs. 38,000 to 2¼ lakhs). The total trade in steel beams, pillars, girders, and bridge work was reduced from 114 to 92 lakhs. The British share remained fairly stationary, only falling from 58 to 57 lakhs, while Belgian imports shrank from 38 to 28 lakhs, and those from America from 11 to a mere Rs. 54,000. Those from "other countries" remained stationary at about 6½ lakhs. The total trade in bolts and nuts rose from 22 to 28 lakhs. The British share fell from 15 to 14 lakhs, as contrasted with a rise in the case of America from 3 to 4¾ lakhs, and in the case of "other countries" (Germany and Belgium) from 3¼ to 9 lakhs. The total imports of hoops and strips rose from 39 to 43 lakhs, the British share advancing from 27 to 30 lakhs, and that of "other countries" from 4¾ to 9¼ lakhs, while imports from America were reduced from 6¾ to 3¼ lakhs. The trade in nails, other than wire nails, rivets and washers showed a noteworthy expansion from 23 to 43 lakhs, British imports rising from 12¾ to 16 lakhs, Swedish from 1 to 9 lakhs, Norwegian, from Rs. 56,000 to 8¼ lakhs, and German from 1¾ to 3 lakhs. Belgian, imports, however, declined from 4½ to 3¼ lakhs, and those from the United States from 1½ to 1 lakh. The total imports of cast pipes and fittings fell from 76 to 54 lakhs, those from the United Kingdom from 54 to 40, and those from the United States of America from 21 to 9 lakhs. The share of "other countries" advanced from 1 to 5 lakhs.

In galvanised sheets and plates there was a most satisfactory increase in the total imports from 173 to 249 lakhs, and it is most encouraging to observe that the United Kingdom had, practically regained her exclusive position in the trade, British imports advancing from 155 to 235 lakhs. Those from the United States fell from 14 to 12 lakhs, while those from "other countries" were reduced from 3½ to 1¾ lakhs. The returns for tin-plates showed an advance from 100 to 130 lakhs, the British share rising from 96 to 115 lakhs, while American shipments increased from 3½ to 13¼ lakhs. Over a lakh's worth of tin-plates were obtained from "other countries." The total trade in sheets and plates, not galvanised or tinned, increased from 113 to 144 lakhs, the British share advancing from 56 to 66 lakhs, that of Belgium from 31 to 42 lakhs, and that of Germany from 17 to 29 lakhs ; whereas the imports from the United States fell from 5¼ lakhs to Rs. 62,000.

The contraction in the total trade in wrought tubes, pipes and fittings by more than half was noteworthy, the total imports falling from 268 to 114 lakhs. Imports from the United Kingdom shrank from 64 to 49 lakhs, and those from America fell from 187 to 48 lakhs, while imports from Germany increased from 8 to 13 lakhs. In wire nails the total trade rose from 21 to 27 lakhs. The British share remaining fairly stationary at just over a lakh, but the share of Germany being doubled from 7 to 14 lakhs. Belgian shipments were reduced from 11 to 8 lakhs. There was a slight expansion in the total trade in wire rope from 18 to 19¼ lakhs. The British share rose from 15 to 16½ lakhs. American shipments fell from 2.77 to 2.04 lakhs, while those from "other countries" rose from a negligible quantity to just over a lakh.

The trade in steel bars and channels showed a slight reduction from 219 to 212 lakhs. It is noteworthy, however, that the Continent maintained its position, the Belgian share being practically stationary at 117 lakhs. Germany increased her shipments from 21 to 39 lakhs. The British share fell from 37 to 33 lakhs, and that of the United States from 26 to 7 lakhs. Luxemburg and France sent most of the remainder.

### Hardware.

Under the general heading "Hardware," Mr. Ainscough gives the following comparative analysis of imports :—

| | 1921. Rs. lakhs. | 1922. Rs. lakhs. |
|---|---|---|
| Agricultural implements | 18 | 17 |
| Builders' hardware | 23 | 29 |
| Domestic hardware, other than enamelled ironware | 10 | 6 |
| Enamelled ironware | 15 | 16 |
| Implements and tools, other than agricultural implements and machine tools | 55 | 60 |
| Metal lamps | 26 | 46 |
| Parts of lamps, other than glass | 8 | 9 |
| Safes and strong boxes | 4 | 2¼ |
| Stoves | 3¼ | 4¼ |
| Gas mantles | 4¼ | 4¼ |
| Buckets of tinned or galvanised iron | ¼ | ¼ |
| Glass lamps | Negligible | |
| Other sorts | 288 | 200 |

The total imports of hardware fell from 457 to 398 lakhs. The reduction was, it is remarked, particularly noteworthy in the case of the United Kingdom, from 286 to 193 lakhs, and of the United States, from 87 to 62 lakhs. There was, however, an extraordinary increase in German imports from 39 to 89 lakhs. The Japanese share advanced from 16 to 22 lakhs, while that of "other countries" remained almost stationary at 24 lakhs. While British manufacturers are retaining a fair share of their higher grade trade in goods used by Europeans and in industries, German makers are rapidly regaining their position in the bazaars of India in the cheapest forms of hardware and in novelties.

### Electrical Instruments and Apparatus.

There has been a considerable diminution in the total imports of electrical instruments and apparatus, from 335 to 166 lakhs. The falling off was particularly notable in the case of the United Kingdom shipments, which declined from 232 to 116 lakhs. Imports from America shrank from 71 to 14 lakhs, those from Italy from 14 to 9 lakhs, and those from Japan from 3 to 2½ lakhs. Dutch shipments were fairly well maintained at 5 lakhs, while those from "other countries" rose from 10 to 19 lakhs.

### Motor Cars.

The total number of motor cars imported during the nine months rose from 1893 to 3307, but the total value fell from 126 lakhs to 109 lakhs. This is accounted for by the fact that whereas the number of British cars fell from 565 to 330, French from 127 to 37, and Italian from 155 to 95—these reductions being almost entirely in the higher priced cars—the imports from the United States advanced from 512 to 1381, and from Canada from 289 to 1147, the shipments from both these countries representing the cheaper makes of cars. It is practically certain that this decrease in the imports of higher priced English, French and Italian cars is due to the fact that vehicles from Great Britain, France and Italy cannot stand an import duty of 30 per cent. in competition with the cheap Canadian and American types, the effect of the heavy duty being, apparently, to give a preference to the American type of cars. The number of motor omnibuses, vans, and lorries increased from 309 to 379, but the value was reduced from 21 to 17 lakhs. The total imports of motor cycles—including scooters—rose from 543 to 609, but the value fell from 6.67 lakhs to 6.35 lakhs. The British share was reduced from 387 to 347, while that of America advanced from 80 to 103 vehicles. The total trade in rubber tires for motor vehicles increased from 58 to 77 lakhs. The British share rose from 15 to 20 lakhs, that of France from 14 to 29 lakhs, and that of the United States from 11 to 14 lakhs, while Italian imports fell from 7 to 4 lakhs.

### Paper and Pasteboard.

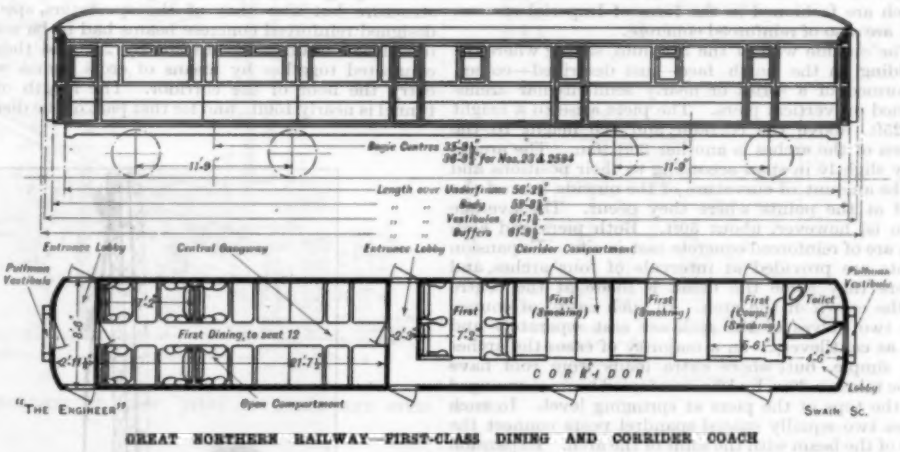
The total trade in paper and pasteboard rose from 15 to 22 lakhs. The British share fell slightly from 7.8 to 7.4 lakhs, while that of Sweden rose from 1.7 to 3 lakhs, Norway from .7 to 2.3 lakhs, the United States from .8 to 2 lakhs, and "other countries"—mainly Germany—advanced from 3½ to 7 lakhs. The value of printing paper imported rose from 57 to 71 lakhs. The British share advancing from 19 to 24 lakhs, that of Norway from 14 to 23 lakhs, and that of Germany from 5 to 8 lakhs. "Other countries" and Swedish shipments fell from 9 to 7 lakhs, Belgian shipments from 3 to 2 lakhs, and the United States from 2.3 to Rs. 37,000. In writing paper and envelopes again there was an increase in the total trade from 37 to 45 lakhs. The British share advanced from 26 to 29 lakhs, that of Germany from 1¾ to 4 lakhs, and that of Norway from 1 to 4 lakhs. Swedish imports remained stationary at 1¼ lakhs, while imports from the United States were reduced from 1.6 to 1 lakh. "Other countries" slightly increased their share from 3.8 to 4¼ lakhs.

### Coal.

Although the total trade fell from 401 to 262 lakhs, the reduction was mainly in Natal, Portuguese East African, and Australian coal. The imports from the United Kingdom were reduced from 182 to 109 lakhs, those from Natal from 112 to 59 lakhs, those from Portuguese East Africa from 55 to 12 lakhs, and those from Australia from 28 to 6 lakhs. At the present time, British coal is largely dominating the Bombay, Karachi and Colombo markets.

## Names of Parts of Railway Coaches.

Having been asked by several readers what are the correct designations of the various parts of a modern railway coach, we have pleasure in reproducing, herewith, a drawing of a Great Northern Railway first-class dining and corridor coach, for which we are indebted to the courtesy of Mr. H. N. Gresley, and on which the names of the different portions are clearly set out.




GREAT NORTHERN RAILWAY—FIRST-CLASS DINING AND CORRIDER COACH

The New South Wales Government announces an extension to November 30th next of the time during which tenders will be received for the erection of the Sydney Harbour Bridge. The extension has been rendered necessary by the adoption of an alternative design for the bridge. The original plan provided for a cantilever bridge of a total length of 3810ft., including a clear central span of 1600ft. While this plan has not been abandoned, contractors may tender alternatively for an arch bridge of a total length of 3770ft., with a main span of 1650ft. In either case the bridge will provide for four lines of railway, six lines of vehicular traffic and pedestrian accommodation. Specifications for both designs may be seen at the New South Wales Agent-General's office in London.

The *Bulawayo Chronicle* recently published news of an important new financial concern, entitled the Rhodesian-Congo Border Concession Company. This report probably has reference to the great copper deposits which are known to extend from the Katanga far across the Rhodesian border, and of which Bwana M'Kubwa is an example. Altogether, it certainly seems likely, according to the *S.A. Mining and Engineering Journal*, that copper mining in Southern Africa will witness a substantial revival in the near future, and if the price of the metal continues to advance as rapidly and substantially as it has done during the past few weeks it is considered locally that a distinct movement in copper mining activity in the sub-continent cannot be long delayed.

# A Seven-Day Journal.

## A Large Railway Workshop Contract.

DETAILS received regarding the contract secured by William Beardmore and Co., Limited, from the Portuguese South and South-Western Railway for the supply, erection and equipment of new workshops at Barriero show that the work to be executed is of considerable magnitude and of great diversity of character. Those submitting offers for the contract were invited to send in their own designs for the workshops and their lay-out. The competition was keen, and was secured by Messrs. Beardmore in face of offers from many other British and continental firms. The workshops are intended for the construction, maintenance and repair of locomotives and other rolling stock, and are to replace the existing shops, which will be demolished to make way for them. A condition of the contract calls for the execution of the work without interfering with the repairing and upkeep of the railway company's rolling stock during the process. The establishment will, by all accounts, be laid out on the most modern lines, and will be the largest of its kind in Portugal. In addition to all the usual departments, it will, when completed, possess a Diesel-electric power-house, a mechanical coaling appliance capable of loading two locomotives simultaneously, and a reinforced concrete water supply tank.

## Proposed New Air Transport Company.

IN accordance with the recommendations of the Civil Air Transport Subsidies Committee, a body presided over by Sir Herbert Hambling, the Air Ministry is now inviting proposals from responsible persons for the formation of a new air transport company to take over the operation of the commercial air services which are now in receipt of subsidies from the Government. The three-year period during which the present scheme of subsidisation will remain in force will end on March 31st next year, and as it may be necessary for the new company to start operations immediately thereafter, it is desirable, it is emphasised, that it should come into existence at an early date. It is advisable, it is intimated, that outline proposals should be submitted by the beginning of next month, for the Air Ministry will hold itself free to close with any offer, which may be regarded as satisfactory, by July 1st. It may be recalled that the Hambling Committee suggested that the company should have a capital of £1,000,000, of which at first £500,000 should be subscribed, and that it should be subsidised to the extent of £1,000,000, spread over a period of ten years. The Committee ruled out the formation of the company by any amalgamation of the three existing air transport companies, although it added a proviso to the effect that in any arrangement arrived at the interests of those companies, in view of the parts they have played during the past three years of difficulty, should not be overlooked.

## British Textile Machinery in China.

IN the Journal for March 16th we reported that a scheme was afoot for the establishment of a textile technical school in China, probably at Shanghai, and that it was hoped that some part of the balance owing to this country from the Boxer Indemnity might be allocated to this object. This scheme, in which the Textile Machinery Makers' Association is taking a leading part, has now been submitted to all the Departments of the British Government interested in it, and has been received sympathetically. It has, too, been very warmly taken up in Shanghai, and a strong committee has been formed to control the local arrangements. The local machinery merchants, it is intimated, feel that they should make some contribution towards the fulfilment of the scheme, and a proposal is being considered for a contribution of funds on a basis of, say, 3d. per spindle on new spinning frames ordered, and, say, 1s. each on new looms. The local mills are also to be asked to contribute towards the support of a certain number of students. It is held by many that the establishment of the school would not only lead to an extension of trade in British textile machinery, but would go far to maintain and enhance the prestige which this country already enjoys in China.

## Trans-Atlantic Wireless Telephony.

Two months or so ago a remarkable demonstration of Transatlantic wireless telephony was given by the Western Electric Company in conjunction with the American Telephone and Telegraph Company and the Radio Corporation of New York. The report of a representative who attended the trials will be found in our issue of January 19th. Previously, of course, isolated words had been transmitted by wireless across the Atlantic, but the occasion referred to was the first on which messages of considerable length at a pre-arranged time had been sent from North America, so as to be heard intelligibly by a large audience in London. The experiment was carried out at night during the winter—that is to say, under conditions specially selected to ensure its success—and is not to be regarded as definitely establishing the immediate practicability of a commercial service. Many difficulties, not all scientific, have, in fact, to be overcome before such a service can be made available. With a view to developing this aspect of the subject, the Postmaster-General has appointed a Committee to consider, from a technical standpoint, the possibility of establishing Transatlantic wireless telephony on a basis of sufficient reliability for commercial use, and to advise what practical steps, if any, can at present be taken to develop this means of communication. The Committee is to consist of Admiral Sir Henry Jackson, Sir F. H. Sykes, Mr. R. A. Dalzell, Professor W. H. Eccles, Mr. F. Gill, and Mr. E. H. Shaughnessy. The telephone authorities in the United States, it is understood, are desirous of co-operating in any studies the Committee may make.

## The Progress of Broadcasting.

THE British Broadcasting Company, Limited, was registered last December, with a nominal capital of 100,000 £1 shares. Under agreement with the Postmaster-General, not more than 60,006 shares may be held by the six major companies, the Marconi, Metropolitan-Vickers, British Thomson-Houston, Radio Communication, General Electric, and Western Electric. The remaining 39,994 shares were made available to other British manufacturers of wireless apparatus, with 10,000 shares as the maximum for any one such holder. According to a statement made by the Postmaster-General, the facilities thus afforded the small manufacturer for joining the Broadcasting Company would seem to be fully appreciated, for there are now about 260 firms which are members of that company. Even so, however, additional figures given by Sir W. Joynson-Hicks reveal the fact, well known already by general observation, that "pirating" is rife, and that considerable business is being done in the manufacture and sale of apparatus not made by firms which are members of the Broadcasting Company. The total number of types of broadcasting receiving apparatus approved by the Post Office is given as 1450, and the number of wireless licences at present issued as about 115,000. Of the latter, 80,000 are in respect of receiving sets bearing the trade mark of the British Broadcasting Company, so that approximately 30 per cent. of the sets in use have been made by outside firms or individuals. It does not, of course, necessarily follow that the owners of all these sets have escaped payment of the Broadcasting Company's royalty.

## The Underground Car Tests.

IN our issue of February 9th we gave particulars and illustrations of six different types of car for the London Underground Railways, each car having been designed and built by a different firm, which the company was then putting into trial service, with a view to discovering which type was the most suitable. The cars were, as to five of them, supplied by the Birmingham Carriage and Wagon Company, Cammell, Laird and Co., the Gloucester Railway Carriage and Wagon Company, the Leeds Forge Company, and the Metropolitan Carriage and Wagon Company, the sixth car being built by the Gloucester Company to the Underground's own design. The cars have been running now for several weeks on the Piccadilly Tube, and the company's verdict is in favour of its own design as being the most suitable for general service, although there are certain improvements in the firms' designs which are worthy of adoption. Orders have now been placed for 191 cars, at a cost of £710,000, delivery to begin in September. The firms to which the orders have been allocated are Cammell Laird, the Metropolitan and the Birmingham companies.

## Two New Liners.

DURING the past week two large liners have been completed, and after running successful trials have been handed over to their owners. The first of these vessels is the Veendam, a large twin-screw Holland-America liner, of 15,400 tons, built and engined by Harland and Wolff, at Govan and Belfast. Like her sister ship the Volendam, the Veendam has a length of 575ft., a breadth of 67ft., and a depth of 44ft. 9in. She has accommodation for 300 first, 382 second and 1222 third-class passengers. The main propelling machinery comprises twin sets of Brown-Curtis turbines, with single reduction gearing. All auxiliary machinery is electrically driven, and there are over thirty electric motors in the engine-room. Steam is generated at 215 lb. working pressure in nine water-tube boilers, which are fitted for oil burning under forced draught. On Wednesday, the 4th inst., the steam trials of the Conte Verdi, the sister ship to the Conte Rosso, were run on the Firth of Clyde. The only difference between these two Italian Lloyd Sahaudo liners—both of which were built and engined by William Beardmore and Co., Limited, at Dalmuir—is that the new ship has a strengthened superstructure and embodies a slight rearrangement of the passenger accommodation. The double-reduction geared turbine machinery is designed to develop 20,000 indicated horse-power, corresponding to a service speed of 18½ knots. The Conte Verdi is 591ft. in overall length, 74ft. in breadth, and 40ft. in depth to shelter deck. She has accommodation for 230 first-class, 290 second-class and 1880 third-class passengers, and a crew of 420, a total ship's complement of 2820 persons.

## Lead Paint.

IN 1911 a Departmental Committee of the Home Office was appointed to consider the dangers arising from the use of lead paint. Reporting in 1915 it found the dangers proved, and recommended that the use of lead paint should be entirely prohibited, except for a limited number of exemptions to be granted separately by the Home Secretary. It based its decision very largely on the possibility of the employment of satisfactory alternatives to lead or on the anticipation that such alternatives would speedily be forthcoming. In 1921 a second Departmental Committee was appointed to inquire as to whether the recommendations of the first Committee required modification and to re-examine the whole question. It has now issued its report, and has come to the conclusion that it cannot support the recommendation of the first Committee as to entire prohibition. The dangers are admitted to be serious, but it is held that they can in large part be eliminated by statutory regulations rather than by prohibition. The Committee is satisfied that there is at present no efficient alternative for white lead or sulphate of lead, and gives instances to show the longevity of the protection afforded by lead paints and the poor results obtained by the use of non-lead paints. Among the regulations suggested by the Committee is one making the dry rubbing down of lead paint illegal, the process, if adopted, to be carried out by wetting the surface and employing waterproof sandpaper. The recommendation is made that a technical Commission should be appointed to investigate problems connected with British paint technology, and, in particular, to study the development of a lead-free paint.

## Sixty Years Ago.

IN our issue of April 3rd, 1863, we recorded the successful accomplishment of a high balloon ascent by Messrs. Glaisher and Coxwell, undertaken for scientific purposes with the financial help of the British Association. The balloon, of 90,000 cubic feet capacity, began its voyage at Sydenham in the late afternoon. Over Clapham it reached a height of about two miles, and over the Isle of Dogs it attained an altitude of 4½ miles. It eventually landed at Barkingside, 2½ hours after the ascent. Observations were made of the ozone content, the temperature, the sun's spectroscopic image, and other factors. According to a reply given in Parliament by Mr. Laird—presumably a member of the well-known Birkenhead firm—our shipments of munitions of war to the Northern Federal Government between May, '61, and December, '62, included 41,500 muskets, 341,000 rifles, 26,500 gun flints, 50 million percussion caps, and 2250 swords, besides many cargoes of "hardware" of more than suspicious authenticity. It was recorded as something of a grievance that the Federal Government showed no willingness to regard these shipments in any way as an offset to the "escape" of the Alabama and the construction in this country of other vessels for the "Emperor of China"—otherwise the Confederate Government. Letters were printed from Sir William Armstrong and Earl de Grey in connection with the resignation by the first-named of his position as Engineer for Rifled Ordnance and Superintendent of the Royal Gun Factories. Sir William desired to be set free in order that he might join the Elswick Ordnance Company, an undertaking formed by certain of his friends at his persuasion. In a note headed "Proposed Tower Bridge," we read that the Board of Trade was opposed to the scheme for constructing a foot passenger's bridge from Irongate Stairs to Horseleydown Old Stairs on the Thames, on the ground that the bridge would greatly interfere with the traffic in the Pool. In a paragraph particulars were given of the performance on trial of H.M.S. Black Prince, with the object of controverting superior claims made for her sister ship, the Royal Oak. It is interesting to record that the Black Prince, subsequently the Emerald and later still the Impregnable III., left Devonport last Saturday for the ship-breakers' yard.

## Gas Producer.

rnt during the recent war was the
on of our fuel resources by the
. Many schemes for this purpose
have been formulated, founded mainly with the object of recovering oils and spirit and producing smokeless fuel in the shape of semi-coke. The Siemens gas producer is in effect a furnace with a deep bed of fuel, by which complete combustion occurs at two distinct stages. Under high temperature with restricted air combustible gas is generated from the whole of the carbonaceous ingredients, leaving nothing behind but ash. The average thermal efficiency of such producers is about 70 per cent., the other 30 per cent. being lost in the dissipation of radiant heat, unconsumed fuel and heat in the ash, and heat obtained from outside sources for generating steam for blast purposes. In the Mond ammonia recovery gas producer the introduction of a larger amount of steam with the air blast brings about the gasification of the fuel at lower temperatures, thus permitting the recovery of some of the nitrogen in the fuel, generally as sulphate of ammonia. The gas thus produced contains a high percentage of hydrogen and is low in carbon monoxide.

A new type of producer has recently been introduced by the R.G. Syndicate. It is designed in accordance with the patents of Mr. T. Roland Wollaston, 26, Corporation-street, Manchester, whose aims have been to secure higher thermal efficiency, to obtain by-products more efficiently, a higher value gas of good chemical constitution, and to extend the range of fuels available. The first plant constructed has been in use for some time at the Fishwick Dye Works at Preston, where the gas generated is being used for firing one of a battery of Lancashire boilers. The plant is not equipped with gear for the recovery of ammonia or tar products, but apparatus is provided for testing the potential yields of the gas produced. A sectional view of the plant is given in Fig. 1. The plant consists essentially of a mechanically fed coal hopper A, a retort B, which also acts as an outlet for the gas, and a producer C. The retort B is of novel construction, the fuel being kept open and in constant movement while in contact with the hot outgoing producer gas. In this retort the fuel travels downwards from shelf to shelf under control of slowly moving spiral rakes and is finally dropped into the producer in the form of coke or semi-coke. The gas from the producer enters the retort at a temperature of about 600 deg. Cent. and is cooled and enriched both as regards thermal value and potential by-products before leaving the retort at the top. There are several original features in the design of the producer C, as will be seen from the sectional drawing. In the first place, it is unlined, or only partially lined, with refractory material and is surrounded by an annular water space forming a boiler for steam-raising purposes. The heating surface is sufficient to provide the whole of the steam required to drive the Roots' blower, the feed pump, the coal elevator, the revolving rakes in the retort, and the revolving crushing rolls to which reference will be made later. The producer is fitted with a Duff grate, but has in addition a central hollow vertical cone D, to the upper part of which the air blast from the Roots' blower is introduced. A water spray is also provided at K, and the water thus introduced is vaporised by the heat of the shaft D. The blast of air is also heated by the same means. The bed of fuel does not rest upon ash piled in the water lute, as is customary in producers with water bottoms, but is carried by corrugated crushing rolls F, which are caused to rotate inwardly at a very slow rate—actually once in six minutes — by suitable mechanism, or they may be stopped altogether. This crushing mechanism enables the operator to draw ash at will from any segment of the producer. Any ash and clinker that is formed is broken into small pieces and is discharged into the V-shaped water lute, whence it can be propelled by water circulation by means of a low-duty centrifugal pump to a central sump, from which it can be elevated by suitable mechanism.

A typical analysis of the gas obtained from the plant at Preston is as follows:—CO, 17.1 per cent.; H, 24.3 per cent.; $CH_4$, 3.9 per cent.; $CO_2$, 10.5 per cent.; N, 44.2 per cent.; total combustible constituents, 45.3 per cent.; gross value B.Th.U. per cubic foot, 182.9; and net value B.Th.U., 164.9. The experimental producer is 9ft. diameter and is capable of gasifying about 13 cwt. of coal per hour. It is operating on small coal and slack, and has worked well with fuels containing upwards of 40 per cent. of ash.

The attached efficiency diagrams are, in detail, only given as approximate and have not yet been independently verified. They are given here with a view to indicating concisely the nature rather than the degree of the improvements as compared with former practice. As is natural with plant embodying so many novel features, the first example has shown openings for improvement. The retort, for example, though mechanically remarkably efficient in dealing with difficult fuels, will generally in future have increased coking capacity, particularly for certain applications not originally contemplated, but now obvious. Difficulties foreshadowed as regards the use of sticky fuels seem to have been, throughout the experiments, conspicuous by their absence. We are informed that the fuel reaching the producer from the retort has been invariably satisfactory from all the raw fuels tried, that very little poking is required, and that clinker formation is inappreciable. Modifications in the shape of teeth and movement of the crusher rolls are in view, as those at present employed were found to "pocket" ash dust. The new design will be rendered self-clearing by simple means.

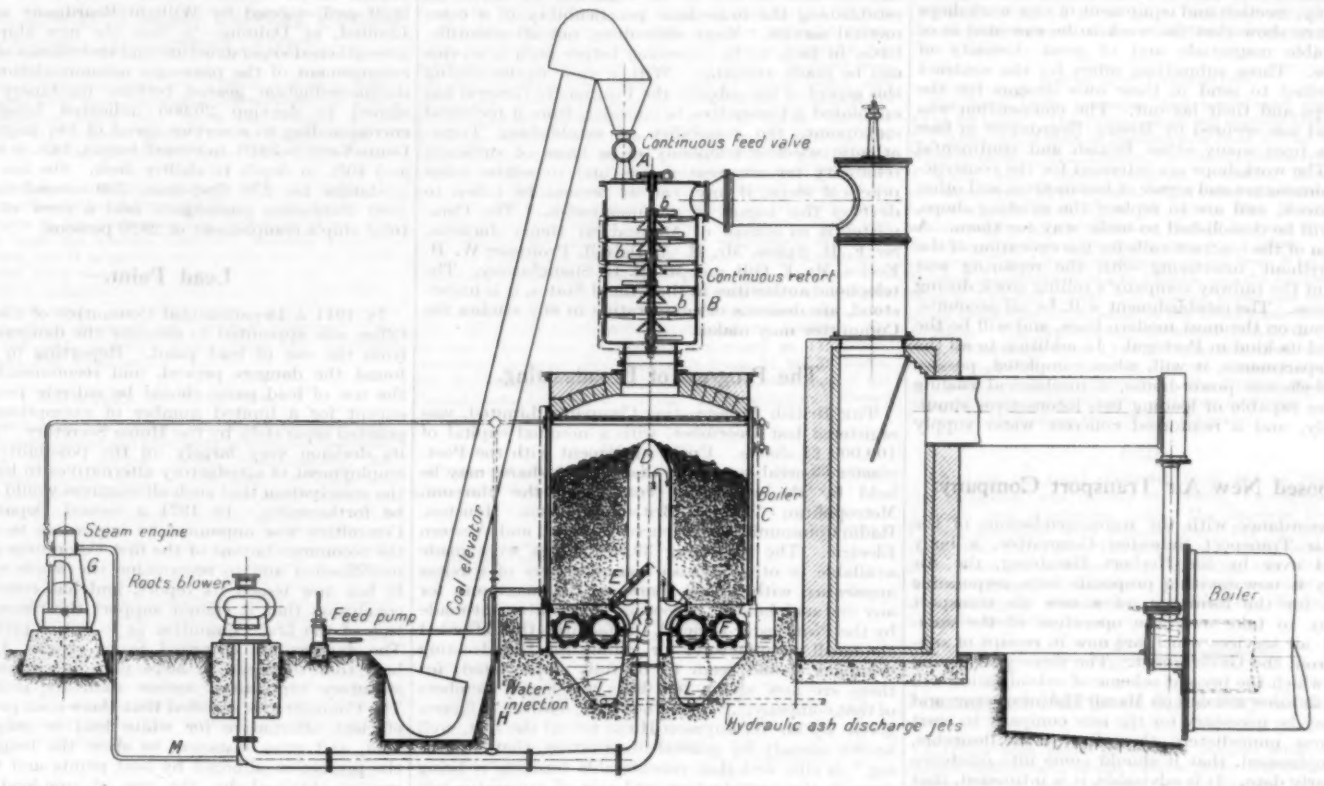



FIG. 1—GENERAL SECTION OF "R.G." GAS PRODUCER PLANT AT PRESTON

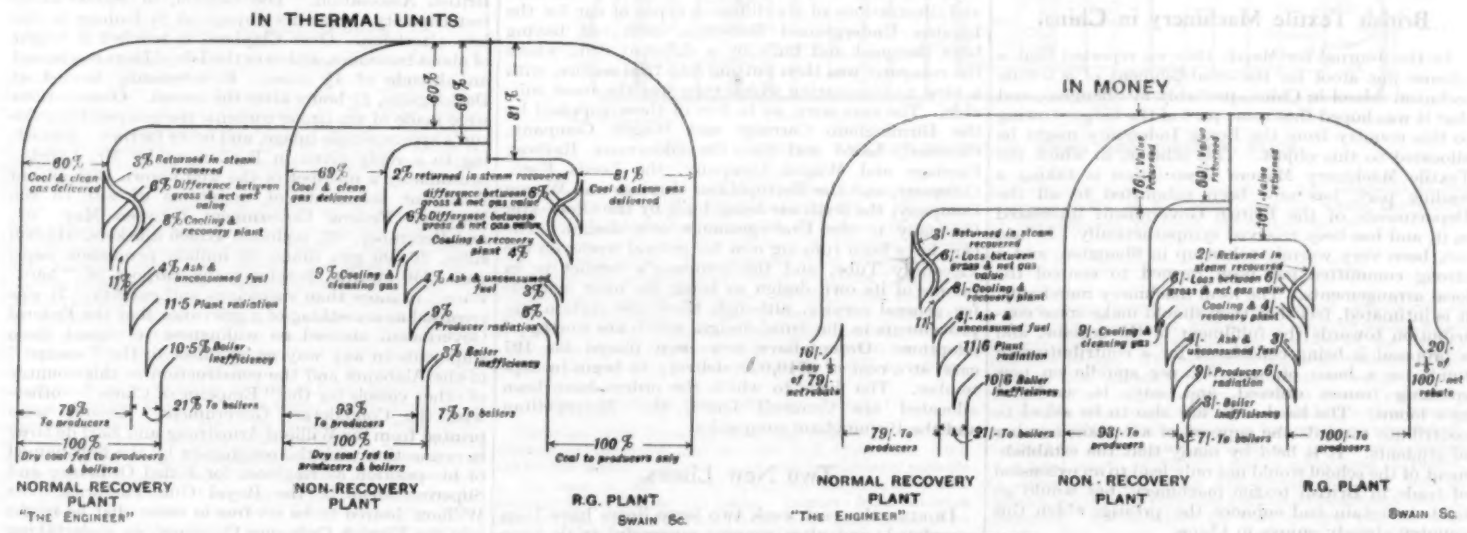



FIG. 2—APPROXIMATE EFFICIENCY DIAGRAMS FROM PRODUCER PLANTS

## Institution of Naval Architects.

No. III.*

THE paper by Mr. W. Le Roy Emmet on "Electric Ship Propulsion," taken on Thursday afternoon, the 22nd ult., and read in the absence of Mr. Emmet by Mr. Bevis P. Coulson, jun., opened up another long discussion. A summary of this paper appears on page 376.

Engineer Vice-Admiral Dixon said that the application of electric propulsion to warships had not been overlooked by the British Admiralty, but the decision had been reached that the case for electric propulsion had not been established. With regard to the claim for improved economy of operation, that was not the first consideration in the case of warships, and it was obvious that the installation of machinery of greater weight must lead to disadvantages from other standpoints unless the additional weight occupied by the machinery was counterbalanced by a corresponding saving in the weight of fuel carried. Experience in the British Navy indicated that the geared turbine could, for all practical purposes, be made as efficient as electric propulsion. The question of the extra space occupied by electric machinery, which had not been dealt with by Mr. Emmet, was a vital consideration in the case of a warship, the design of which was a compromise between opposing factors, and where every foot of space had to be most carefully considered, as it might mean the sacrifice of an important fighting or defensive feature. It would seem that electric transmission plant, as compared with the geared turbine drive, required an additional floor space of not less than 20 per cent. It was true that against that it was argued that electric transmission enabled a greater subdivision to be made of the machinery, but from the naval standpoint the advantages claimed under this head were more apparent than real. It could be said in favour of the geared turbine that it had come with a successful record out of the trial and stress of the naval war, and although the advance of electric propulsion for ships would be watched with interest and taken into consideration when new ships were being designed for the Navy, in its present stage of development it would seem that its disadvantages outweighed its advantages in the case of warships.

Sir Thomas Bell said that Mr. Emmet was to be congratulated on his courage in embarking on the wholesale manufacture and intensive production of machinery, of which he had had no very definite or extended experience. The firm with which he (the speaker) was connected had fitted double reduction-geared turbines in three large passenger ships which had been in service for some time, and in two other passenger steamers had installed single reduction-geared turbines. Their experience had been satisfactory, and from knowledge of performance gained under service conditions he took exception to the statement of the author that low-speed turbines could be more safely and easily operated through gearing than high-speed turbines. He was unable to see what advantage in the case of passenger ships could be claimed for electric propulsion.

Sir Eustace d'Eyncourt said that having regard to the conditions which were laid down by the Washington Conference any economy arising from the adoption of the electric drive, which might be associated with cruising speeds was of no importance, while it was clear that the extra weight of electrical machinery as compared with geared turbine plant must reduce the fighting qualities of the ship. Reference had been made to the additional space required for electrical plant, and it had been found in a provisional design which had been got out for a warship, that to compensate for the extra space required it would have been necessary to encroach considerably on the magazine space, which, of course, put electric propulsion out of court.

Mr. Robert J. McLeod said that at the beginning of last year he had made a visit to the United States and had been given an opportunity of inspecting the electrical equipment of the newer battleships and cruisers, and of discussing the whole question with American naval officers. He had also spent some time with Mr. Emmet and the engineers of his company at Philadelphia and Pittsburg. He was able to say that every naval officer in the United States service was enthusiastic on the subject of the electric drive for warships, and he had heard of none of those troubles such as were associated with mechanical gearing. If he might suggest an explanation of the smaller percentage of failures of gearing in warships as compared with merchant ships, it was that while warships ran only occasionally at full power, merchant ships were driven at full speed for the greater part of the time they were at sea, and the stresses on the gearing were, therefore, of a continuous character. The weight and space question had been raised in connection with the electric drive, but he would point out that in the United States they had designed their new ships from first principles, and reduced the machinery weights to a greater extent than might seem possible to those who had only a cursory knowledge of the subject. He would like a definite comparison by British engineers who were opposed to the electric drive to show what they could do to compare with the hypothetical ship laid down by Mr. Emmet. It could not be disputed that with the electric drive boilers and generators could be placed in a more convenient position in the ship. The question of reversing was of some interest in connection with the electric drive, as reversing could be carried out more simply, and it was an advantage that a higher degree of superheat could be used with the electric drive and turbines always running in one direction than in a system which made the use of reversing turbines necessary. He had come to the conclusion that the geared turbine must be less efficient than the electric drive. The work done in the United States had proved the greater reliability of this system for large ships owing to the plurality of the units. Personally, he had very little doubt as to the future of the electric drive, and he was the more convinced of its superiority to any other system from the fact that the cost of upkeep of the electrical equipment in the United States warships had been practically negligible. He would like to see two sister ships built, one fitted with the electric drive and one with the geared turbine, and a series of comparative tests carried out.

Commander S. V. Goodall said he had been at sea in the New Mexico, the first electrically-propelled battleship, and he had been all but persuaded of the superiority of electric propulsion as compared with geared turbines. At that time the fuel consumption for the battle cruisers of the "Lexington" class, which was guaranteed by the contractors, varied from .98 lb. of oil per shaft horse-power per hour at full speed to 1.20 lb. at 19 knots, these figures being the consumption for all purposes. Mr. Emmet was now prepared to guarantee a figure of .85 lb. at 19 knots and full speed, but even this great improvement in fuel consumption did not establish the case for electric propulsion in warships, as the saving in fuel did not compensate for the increase in machinery weights. Taking Mr. Emmet's figures he had worked out the effect on the recently scrapped battle cruisers of adopting electric propulsion. A veritable rake's progress was the result. The engine-rooms had to be longer, the horse-power increased, the weight of armour therefore increased, and the size of ship increased. Calculations showed that the vessels would have been 50ft. longer, the light displacement higher by 3500 tons, and as the result it would have been impossible to dock the ships at either Portsmouth or Rosyth. He had also worked out a scheme of electric propulsion for the new capital ships Rodney and Nelson, and found that the ships would be 20ft. longer and the displacement 1000 tons in excess of the limit fixed by the Washington Treaty. It was obvious that unless the weight and space of electric machinery could be very much reduced, the death blow to electric propulsion for warships had been given by the Washington Treaty.

Mr. Bevis P. Coulson, jun., in replying on behalf of the author to the points raised in the discussion, admitted that weight and space questions were of great importance and required to be discussed in detail. There was no doubt that electric propulsion was gaining ground. Following the construction of the San Benito, a 3000 shaft horse-power ship, equipped with electrical machinery, three vessels of the same type had been ordered by the United Fruit Company. The Japanese Government had just taken delivery of an electrically-propelled collier, and he felt confident that the electric drive would be generally adopted in the Japanese Navy. Comparisons were available of the electric drive with the geared turbine. It had been shown in regular trials that the manœuvring qualities of the New Mexico were vastly superior to those of the geared turbine ships Idaho and Mississippi. The fuel consumption of the geared turbine ships also compared unfavourably with that of the New Mexico. At 10 knots they consumed 20 per cent. more fuel, at 15 knots, 42 per cent. more fuel; at 16 knots, 47 per cent. more; at 19 knots, 40 per cent.; and at 21 knots, 32.2 per cent. more fuel. Reference has been made to the weight question. If an Atlantic liner similar to the Empress of Canada were taken, it would be found that the large double-reduction gears weighed 200 tons, which was about 37 lb. per shaft horse-power, and the weight did not include the four turbines. Electrical equipment would compare favourably with that figure. On the question of the space occupied, he was able to state that in the case of the California the machinery spaces had, been narrowed to a degree which enabled 300 tons to be saved in armour plating. On the weight question, he would also point out that there was a big saving in piping with the electric drive as well as a saving in shafting, as the motors could probably be put nearer the stern of the ship. In America they were convinced of the advantages of the electric drive, and could not understand the objections which had been raised by British engineers. Unfortunately, or fortunately, as the case might be, it would not be possible to test the fighting qualities and military advantages of the electric drive compared with other methods of propulsion, unless there was a war between Great Britain and America, and he prayed that that might never happen.

Mr. W. C. S. Wigley then presented the paper by himself and Mr. G. S. Baker, "Model Screw-propeller Experiments with Mercantile Ship Forms."

### MODEL SCREW PROPELLER EXPERIMENTS WITH MERCANTILE SHIP FORMS.

This paper gives an account of the experimental research work carried out in connection with screw propellers at the Froude tank during the last two years. The testing apparatus has been improved by adding a device for measuring the torque in the propeller driving shaft, and for the experiments on waves the existing wave-making apparatus was used.

*Effect of Immersion of Screw on Thrust and Efficiency.*—A systematic set of experiments have been carried out on seven screws of different normal types for the purpose of determining the effect of immersion on thrust and in one case on efficiency.

It is found that at working slips of from 30 to 40 per cent. the thrust developed by the screw begins to fall off as soon as the centre of the screw is immersed a distance of less than 0.6 of the diameter; that is, as soon as the thickness of the layer of the water over the tips of the screw is less than one-tenth of the screw's diameter. The thrust then decreases with increasing rapidity, as the screw is raised always at a greater rate than does the immersed area experiments to determine the effect of a rigid boundary in proximity to the screw show that thrust and efficiency are unaffected by such a boundary until the blades make contact with it. There was no detectable difference between the records of thrust and torque in deep and very shallow water. It is the presence of air and its mixture with the water in contact with the blades which is believed to account for the large variation experienced in the model screws.

*Experiments in Waves.*—Some experiments were made with a propeller advancing through waves, and the screw was run both advancing into and being overtaken by the waves. The waves varied from 3.2in. to 6.0in. (0.4in. to 0.75in. diameter) in height from crest to hollow and from 1.57 to 1.75 seconds in period. With the screw just breaking through the surface at about every other wave hollow, when meeting waves at 217ft. per minute, the screw gave nearly the same thrust as in smooth water with approximately the same torque up to slips of 40 per cent., when the falling off of both thrust and torque became serious. The variation in torque as each wave passed was 8 to 16 per cent., the higher percentage applying to the smaller torques; similar figures for overtaking waves were 10 to 16 per cent. Similar trials with lighter immersions were made. The small falling off in thrust and efficiency in waves with small immersion of the blade tips and moderate slips, the very large falling off in thrust with greater immersion or large thrusts, and the not very great drop in efficiency are in general agreement with the results at varying immersions in still water.

*Screws Behind Model at Varying Immersion.*—A number of single-screw models have been run with the screw propeller behind. When analysed on lines laid down by Froude, the results for load conditions show in general: (*a*) a thrust deduction fraction increasing slowly with fulness of form and a wake fraction increasing much more rapidly with fulness, so that hull efficiency steadily increases with fulness; (*b*) the thrust deduction and wake fraction are independent of minor alterations of blade area, independent of pitch for quite fair variations, but vary with the rake back of the blade tips, both decreasing as rake is increased; (*c*) when through any cause the resistance to be overcome by the propeller is increased, the thrust deduction increases; (*d*) in ballast condition with twin-screw ships the thrust deduction and wake fractions are practically the same as for deep load. The effect of fore-and-aft position of the screw on wake and thrust deduction fractions was determined by experiment, and Taylor's results are quoted. Complete tables and curves are given and the practical application of the results to full-sized screws is discussed.

Mr. Richard Williamson said that the design of a propeller depended largely upon information obtained from other vessels. The author had provided an amount of information that was particularly interesting to him, because since 1900 he had endeavoured to improve the efficiency of coasting steamer propellers. Prior to the year 1900 his company had built and owned coasters that traded within the home trade limits. They were full in form, about .75 block coefficient, and had propellers designed in accordance with marine engineering practice at that time. The results obtained in moderate weather were fairly satisfactory, but when wind and sea increased, the efficiency of these ships was reduced in a very marked degree. This did not satisfy him, and he considered how propeller design could be improved. He came to the conclusion first, that the propeller surface was too small; and, secondly, that the blades were working too close to the shell plating. His object in making experiments was purely commercial, and in that connection reliability was perhaps more important than anything else. In the coasting trade, economy in fuel, although an important item, was a secondary matter when compared with propeller efficiency. He decided to make small alterations in the propeller. The firm's practice had always been to build from three to six duplicate vessels for each model, and this enabled him to obtain more reliable information. Progress was slow; some owners refused to allow any alteration from the engineer's design, others readily assisted. They started first to increase the hang back 3in. in each vessel, making a corresponding increase in the propeller surface and pitch, and found that efficiency was increased as the set back increased. During the twenty-three years which had elapsed since starting the experiments, the diameter of the propeller had been increased 9 per cent.; the pitch, 7½ per cent.; the surface, 24 per cent.; and the set back, 75 per cent.; whilst the piston speed had been reduced 27 per cent. They asked the National Physical Laboratory to make further experiments, and for that purpose handed Mr. Baker full particulars of hull and propeller design. Mr. Baker found that hang back was very advantageous in propelling a vessel of full form in heavy weather. One of the steamers owned by his firm was employed during the war for about three years carrying mails, parcel post, and other light cargo between Folkestone and Boulogne. She had to make a passage across one day and return the next. The captain informed him that during the whole of the period she was on charter to the Government she was only prevented from making her passage upon three occasions through stress of weather. He also stated that exceptional weather had stopped the troopships for five consecutive days when their ships had made the passage.

Mr. W. J. Luke remarked that all those interested

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in this work would be glad to learn that the Froude tank was now so well equipped. He might remind members that about fifty years ago Osborne Reynolds made some experiments which were published by the Institution dealing with thrust on a model propeller at different immersions. His conclusions were the same as those reached by Mr. Baker that thrust increased rapidly as immersion was increased, until a point was reached when the immersion had no further effect on thrust. A shipowning friend of his in Norway had experienced the same kind of trouble as that referred to by Mr. Williamson. He possessed a number of vessels of the same type and carried out the experiment of increasing the clearance between the edge of the propeller and the body post, finally reaching a condition of affairs which was the result of Mr. Williamson's practical experience. Another point investigated was the variation in thrust when the vessel was pitching. It had been generally found that only a comparatively poor performance could be obtained from a tramp steamer on general service, and it was clear that propeller problems ought to receive more attention.

Mr. E. R. Mumford said the Froude tank was now equipped with apparatus for measuring the torque as well as the thrust and revolutions per minute of model propeller shafts, and had also been fitted with wave-making apparatus. At the tanks of firms engaged in commercial work very little time was available for research work, but it was of interest to note the extent to which results obtained at Messrs. Denny's tank supported and confirmed the results published in the paper. The need of having the model propeller similar to the actual propeller, and also the adoption of a propeller boss of about normal size, agreed with the experience gained at Dumbarton. The variation of thrust and efficiency obtained in the Dumbarton tests in relation to varying immersion and emersion agreed with the results given in the paper, and he was also able to confirm what was said as to the effect of altering the fore and aft position of the screw in relation to the stern of a full lined ship. The authors dealt with the effect of boundary surface in a clear and convincing manner, and the explanation given as to the cause of reduction of thrust in surface breaking propellers with consequent small reduction of efficiency, was doubtless correct. In the investigations at Dumbarton on the efficiency of vane wheels, the falling off of thrust at high slips was very pronounced, although the propulsive efficiency did not fall off to an equal extent. The diagrams which the authors gave, illustrating what happened with the propellers advancing through waves, were interesting, as showing that reduction of thrust due to air drawing was aggravated by surface waves, particularly when the slip was excessive. The authors reached the conclusion that there appeared to be a limiting thrust depending on the immersion and the diameter of the screw, and it would be of interest if the investigation could be pursued, especially as Messrs. Denny were at the present time making a similar investigation in connection with vane wheels. The variation in torque with pitch of vessel given in the paper was very interesting. The conclusion that the thrust curve in open water had not necessarily any application to conditions behind the model, coincided with the experience gained at the Dumbarton tank, and was most pronounced in the case of vane wheels.

At the evening meeting, on March 22nd, the paper by Mr. K. C. Barnaby, "The Powering of Motor Ships," occupied the entire session. The following is a short *précis* of this paper :—

### THE POWERING OF MOTOR SHIPS.

This paper dealt with the question of propeller efficiency and was accompanied with diagrams and curves, by means of which the suitability of a particular type of Diesel engine for any proposed ship might be decided upon. The diagrams were worked out on the basis of a narrow four-bladed propeller and a pitch ratio of 0.8 to 1.2 was taken, these values forming approximate limits of suitability. On the main diagram connecting power and revolutions and speeds of advance of the various types of Diesel engine were plotted, while an auxiliary curve showed the relation between sea speed and speed of advance for various block coefficients with single and twin-screw arrangements. The Sulzer range of engines and the Burmeister and Wain long-stroke engines, along with the Werkspoor and Fullagar types, were shown to conform to definite lines, and generally it was shown that the various engines in service and in course of manufacture are all suited to cargo boats of any size and power, provided the sea speed is not less than 10 knots. Engines of higher speed should be used for faster boats. Reference was made to the loss of power sustained when working under tropical conditions, and a figure of from 5 to 10 per cent. was given for the loss. The author recommended that the power of engines should be expressed in brake horse-power. A proposed design for a passenger and cargo motor ship was illustrated, and a table with dimensions of typical motor ships was included in the paper.

Mr. James Richardson said that with the advent of the motor ship and the rapid development of the marine Diesel engine, a number of the problems which were common to all types of ships, apart from the main machinery, had been solved, and other questions had been attacked from a new angle. As an instance of the former, he would refer to the electric driving of all the ships' auxiliaries, and of the latter, a notable example was the selection of the most suitable type of propeller. The author made a plea for a reduction in the speed of revolution of marine motors with a view to the fitting of propellers of higher efficiency. As a general axiom, this plea was fairly well founded, but in many cases it would be found that the fitting of a somewhat small propeller, and the installation of an engine of slightly greater power, would give a better overall performance of the ship. With a constant piston speed, whether the engine ran at 85 to 90 revolutions or 115 to 120 revolutions, the saving in weight, space, and first cost of the higher speed Diesel engine, even allowing for the slightly extra power which had to be installed with a higher speed propeller, was not inconsiderable, and in some cases made all the difference between success and failure as a motor ship. An illustration of this was the performance records of the motor ships Pinson and Pizarro. The speed of the motor ships, compared with a similar steamship on the basis of the Admiralty coefficient, showed in the case of the motor ship figures varying from 180 to 236, dependent upon the weather experienced, whereas the steamship in good weather gave a coefficient of 190. The speed of the motor ship averaged 1 knot higher than the steamship in all weathers, and the consumption of oil fuel was one-fifth that of the coal used by the steamship. The propellers in the case of the motor ship ran at a speed of from 115 to 123 revolutions per minute. Referring to the suggested reduction in power with the Diesel engine when working in the tropics, his experience indicated that increase in temperature of the air charge in the working cylinders due to tropical conditions was of less importance than the more easy atomising of the fluid fuel, although he admitted that in the case of certain two-stroke cycle engines, where the margin of oxygen within the cylinder was more nearly a limiting figure, the power output might be reduced. Except in very special cases he was not an advocate of the interposition of mechanical or electrical gearing between the Diesel engine and propeller, and the argument put forward by the author that the Diesel engine was not a good reverser would not stand. Recent experience when navigating the Manchester Ship Canal, without the aid of tugs, had proved that the problem, not only of the reversibility but of the flexibility of the marine Diesel engine, had been solved.

Mr. G. S. Baker said that the paper was only the first chapter of a broad survey of the subject which Mr. Barnaby had set himself out to make. It was useless to install a highly efficient engine and propeller if for reasons of overall efficiency the ship was not going to be profitable. In connection with the propeller part of the problem, Mr. Barnaby had necessarily followed the published data and assumed that the screw would always be placed in a good position, but he need hardly say that was not always the case, and quite large percentages of efficiency could be thrown away by the screws being placed in the wrong position. Another factor which had to be borne in mind in going from a reciprocating or turbine engine to the internal combustion engine, was that the turning moment on the shaft of an oil engine varied considerably more than in the case of a reciprocating engine, and with a vessel of fairly full form there was more danger of a breakdown in thrust. With regard to the suggestion to employ reduction gearing with a high revolution Diesel engine, that would probably lead to trouble and increase the liability to thrust breakdown owing to the variation in torque. Compared with the turbine drive the tooth pressure would be increased and this might cause difficulty.

Sir John Thornycroft, referring to the suggested falling off of efficiency of the Diesel engine when working in the tropics, said that this might be due as much to the lower efficiency of the *personnel* as of the engine. He was not prepared to admit that the four-cycle engine showed lower efficiency under tropical conditions.

Mr. W. G. A. Perring said that the problem of powering a ship was a very difficult one, partly because of the many factors involved but also because of the lack of data connecting trial and model experiments. It had to be admitted that the conditions that existed for screws working behind ships rendered co-ordination of data a very complicated task. It was necessary to connect the naked effective horse-power of the ship and the indicated horse-power or brake horse-power of the engine. Mr. Barnaby had connected the propeller results in open with the ship by using an empirical wake, but it was still necessary to allow for other factors, including appendage and wind resistance, thrust reduction, and relative rotative efficiency before the naked effective horse-power could be connected with the brake horse-power. This could be cone by use of a coefficient of the form $\text{B.H.P.} = \frac{\text{E.H.P.} + \text{Appendage Resistance}}{\text{Quasi Propulsive Coefficient}}$ where Q.P.C. = hull efficiency × propeller efficiency × relative rotative efficiency. This coefficient, besides establishing a connection between two important items and covering the intermediate steps, had the additional advantage of being directly measurable by model experiment when the torque delivered to model propeller was recorded. It would be of great interest if the author could state what effect the fast running propeller of the motor ship had on the items that made up the Q.P.C. and on the coefficient itself. Carefully conducted deep load trials of single and twin-screw motor ships which were recorded in a paper read at Copenhagen showed the coefficient to vary from .631 to .674.

Mr. Williamson, speaking as an owner of tramp steamers, said that he was exceedingly doubtful as to the suitability of Diesel engines for vessels in that class of service, partly on account of the difficulty which would arise in respect of *personnel* of the engine-room. He also questioned whether the Diesel engine had the necessary flexibility for tramp steamer work, whereas the reciprocating engine had shown by long experience that it could meet all requirements. A company with which he was associated had the question under consideration at the present time. He did not dispute the great saving in fuel consumption with the Diesel engine as compared with the steamship, but was quite uncertain as to the item of depreciation. He knew what would be the value of a steamship ten to fifteen years old, but he had no information of that character with regard to the motor ship.

Sir George Goodwin, referring to the doubts which had been expressed on various points, reminded the meeting that the Institution, in conjunction with the Institution of Mechanical Engineers, was about to carry out trials of marine Diesel engines under sea-going conditions. The first of these engines would be ready for bench trials next month, and he hoped that these and subsequent tests would elucidate some of the points which had been raised in that discussion.

## DETONATORS.

For many years it was the practice to use fulminate of mercury as a primer in detonators, but about the beginning of the war some little success was obtained in the substitution of the azides or nitrides of a heavy metal for the fulminate. The success was not commercial, but rather experimental, but the matter appeared to be of some importance. In 1908 a patent was obtained in this country covering the use of lead azide as a primer in detonators in substitution for the aforesaid fulminate of mercury, the chief aim being the production of a less expensive means of ignition. This patent was assigned to Nobel's Explosives Company, Limited, which in due course applied for an extension of its term, on the ground that experiments had to be abandoned in August, 1914, owing to the demands made in other directions.

The interesting point is brought out in the official report that in Germany, by reason of a shortage of fulminate of mercury, the invention had been developed to the detriment of the British company. It was explained that at that stage in this country lead azide had not been fully developed, and that as there was no shortage of fulminate of mercury here, and it was the accepted initiator for all detonator work, the authorities had preferred not to use lead azide, an explosive of which they knew substantially little.

It was pleaded that by the employment of lead azide as a substitute for fulminate of mercury a saving of from 4s. to 5s. per thousand detonators could be effected. The company's plant prior to 1911 had not been suitable for the manufacture of lead azide. An experimental plant had to be obtained from Germany, after which difficulties arose owing to explosions which necessitated further research as to lead azide. The company now states that it can produce a satisfactory merchantable detonator primed with lead azide. In connection with its application for extension of the patent, it was proved that upwards of £9000 had been expended in experimental work, and only since the war, by virtue of that expenditure, had it been able to convert the experimental product into a commercial article. The application was heard by Mr. Justice Sargant, who granted an extension of the term of the patent for four years.

## BOOKS RECEIVED.

*Commonsense of the Calculus.* By G. W. Brewster. Oxford : The Clarendon Press. Price 2s. net.

*The Young Man and Civil Engineering.* By G. F. Swain. London : Macmillan and Co., Limited. Price 9s. net.

*Visual Illusions.* By M. Luckiesh. London : Constable and Co., Limited, 10, Orange-street, W.C. 2. Price 15s. net.

*Back to Prosperity.* By Henry Lowenfeld. London : Effingham Wilson, 16, Copthall-avenue, E.C. 2. Price 5s. net.

*Statique Cinématique.* By Robert d'Adhémar. Paris : Gauthier-Villars et Cie, Quai des Grands-Augustins, 55. Price 16f.

*Briquetting.* By A. L. Stillman. America : The Chemical Publishing Company, Easton, Pa. Price 6.00 dollars.

*Cam Design and Manufacture.* By F. B. Jacobs. London : Constable and Co., 10, Orange-street, W.C. 2. Price 13s. net.

*Farm Implements and Machinery.* By J. R. Bond. London : Benn Brothers, Limited, 8, Bouverie-street, E.C. 4. Price 35s. net.

*Papers on Internal Combustion Engines.* London : Institute of Marine Engineers, 85–88, The Minories, Tower-hill, E. 1. Price 12s. 6d.

"*Manchester Guardian Commercial*" *Year Book.* Manchester : The *Manchester Guardian Commercial*, Guardian-building. Price 2s. 6d. net.

*An Introduction to the Principles of Mechanics.* By J. F. S. Ross. London : Jonathan Cape, 11, Gower-street, W.C. 1. Price 12s. 6d. net.

*Jane's Fighting Ships*, 1922. Edited by Oscar Parkes. London : Sampson Low, Marston and Co., Limited, 100, Southwark-street, S.E. Price £2 2s. net.

*The "Rapid" Decimal Calculator and Universal Reckoner.* By J. Gall Inglis. London : Gall and Inglis, 31, Henrietta-street, Strand, W.C. 2. Price 1s. 6d. net.

*Lockwood's Builders' and Contractors' Price Book*, 1923. London : Crosby Lockwood and Co., Limited, 7, Stationers' Hall Court, E.C. 4. Price 7s. 6d. net.

## Railway Matters.

Once more there are forty-minute expresses between Manchester and Liverpool. They are being provided by the former London and North-Western route between Lime-street, Liverpool, and Exchange Station, Manchester.

The reports on those accidents between July and September, 1922, which were inquired into by the Ministry of Transport, have now been issued as a Stationary Office publication, price 3s. They bear no Command number and must, therefore, be ordered as the Railway Accident Reports for the three months ended September 30th, 1922.

It is possible that the fact has passed unnoticed that very few of the cars running on the Metropolitan District Railway bear any outward or, even visible, sign of their ownership. A small number are lettered "District Railway" under the roof, and a few have a monogram on the glass doors of the gangway giving communication from car to car.

Stoke-on-Trent is now better served from Euston in the morning than hitherto. The quickest, reasonable way was by the morning Irish mail at 8.30, changing at Crewe, and arriving at Stoke at 12.40. Now one leaves at 8.45 a.m. and reaches Stoke in less than three hours. This train goes on to Manchester, where it is due at 12.40 and replaces a connection with the above-mentioned Irish mail that arrived in Manchester at 12.33 p.m.

By a judgment given by the Railway Rates Tribunal on the 22nd ult., secs. 54, 58 and 59 of the Railways Act apply to season tickets, traders' tickets, workmen's fares, &c. The companies will, therefore, have to include these tickets in the schedules which they have to deposit by June 30th. These and all other charges are then open to review. Hitherto only ordinary fares and workmen's tickets have been subject to statute, and the season ticket holder will be glad that his turn has come at long last.

The question of the electrification of the railway between Rotterdam and Amsterdam was discussed on March 13th by Mr. J. J. W. Van Loenen-Martinet, chief of the Electric Traction Department of the Netherlands State Railways, before The Hague section of the Netherlands Association of Railway Officials. He stated that on the advice of the Committee of Inquiry it had been decided to adopt the direct-current system, at 1500 volts, although this pressure could be doubled if necessary in the future.

The first contract in connection with the conversion from steam operation to electric traction of the South-Eastern section of the Southern Railway is that for 7500 tons of conductor rails. This contract has been awarded to the Cargo Fleet Iron Company. It has now been decided that direct current at 600 volts shall be used so as to maintain uniformity with the South-Western section. Power will be obtained from the London Electric Supply Association, with which a contract for fifty years has been made.

At the Railway Amalgamation Tribunal on the 27th ult., the absorption by the London, Midland and Scottish Railway Company of the following seventeen companies was agreed to:—Arbroath and Forfar, Brechin and Edzell District, Callander and Oban, Cathcart District, Cleator and Workington, Cockermouth, Keswick and Penrith, Dornoch Light Railway, Dundee and Newtyle, Lanarkshire and Ayrshire, Maryport and Carlisle, Mold and Denbigh Junction, North and South-Western Junction, Portpatrick and Wigtownshire, Solway Junction, Stratford-upon-Avon and Midland Junction, Tottenham and Forest Gate, Wick and Lybster Light Railway.

Further confirmation for the optimistic views as to railway labour we expressed in our leading article on November 3rd last are to be found in the following recent remarks by the chairman of the late London and North-Western Railway:—"I would like to express my very hearty appreciation of the relations which exist between ourselves, as a board, and our employees. For a short time after the termination of hostilities our men were not working well, but in the last year or two the relations have improved very considerably, and I have no hesitation in stating that we have now got past the worst and can look forward to most harmonious working, which will prove of lasting benefit both to them and to you."

The annual conference of the Locomotive and Carriage Superintendents' Committee of the I.R.C.A. was concluded early in March at Lucknow. There was a full attendance under the chairmanship of Mr. A. M. Bell, of the G.I.P.R. Among the most interesting items on the agenda were the arrangements for getting the automatic vacuum brake into full working order on all the goods trains of the broad-gauge railways, as from April 1st, 1924. To make preparation for this step, it was resolved that all railways should get the piping of the different wagons into good form, all defects leading to leakage, &c., being remedied by either welding or other procedure, at once, and that an attempt should be made to maintain continuous vacuum throughout all trains to the rear van, on October 1st this year.

The proposed construction of a railway between Mukden and Kirin has been the subject of discussion in Manchuria for quite a long time. As a result of the joint conference of the civil authorities and the provincial influential bankers, a definite scheme has been prepared showing, first of all, the route of the line, which commences from Mukden, passes directly to Fushun, thence turns northward to Shengking, crosses the Liu River, and proceeds to Kirin *vid* Hailum and Holung as well as Hwatien. This is considered to be the first section. From Kirin to Hailing *vid* Omu and Ningkuta is the second section connecting the Chinese Eastern Railway at its northern terminus. The length of the first section is about 240 miles. It is estimated to cost some £3,000,000 to construct. In raising this sum, the provincial authorities have hinted that a tax of 1.00 dollar should be levied on land owners for each mow of land they possess or that this fund would be temporarily raised from them by the issue of a form of loan, which will be redeemed from the railway surplus by gradual drawings. Tang Wen-kao, former Director of the Peking-Mukden Railway Administration, has been appointed the Director-General of the Preparation Bureau. The latest report from the Government Bureau suggests that work on the line must have been started by now.

## Notes and Memoranda.

According to the *S.A. Mining and Engineering Journal*, the total development work carried out in the Witwatersrand mines since the middle of 1910, has amounted to more than ten million feet. The exact figure is 10,187,884ft., or 1929½ miles.

The tension bars of an old highway bridge in Indiana had become so loose that some of them were slack to the extent of an inch, and thus naturally took no load. The trouble was remedied, according to the *Engineering News-Record*, by heating the bars with a portable forge, without taking them out of place, and upsetting them by hammering on the end until they were reduced to the proper length. The tie bars were about 1in. by 1¼in. in section.

A symposium and general discussion on the subject of the resistance of alloys to corrosion will be held at the Department of Applied Science, Sheffield University, on April 13th. The meeting is being organised jointly by the Faraday Society, the Sheffield Section of the Institute of Metals and the Manchester Metallurgical Society. The scope of the discussion will include the new non-corrodible non-ferrous alloys, such as stainless nickel silver and the nickel chromium alloys, as well as stainless iron and steel.

At a meeting of the Association of Drop Forgers and Stampers at Birmingham, Dr. Leslie Aitchison gave the second of his series of lectures on drop-forging practice. The matters discussed were: (1) Choice of the type of die steel to be employed for the manufacture of any pattern; (2) shape and dimensions of the block selected; (3) laying-out of the pattern on the blocks, both top and bottom; (4) hardening of the blocks; (5) mounting of the blocks in the drop hammer; (6) distribution of size between top and bottom blocks. The method of laying out the pattern involves a careful consideration of the stresses set up in the block itself by different shapes of patterns, and the stresses set up on the hammer during forging.

At a meeting of the Chelmsford Engineering Society, on March 1st, a lecture on "Electricity Supply in Unoccupied Areas," was given by Mr. A. Hugh Seabrook. The lecturer referred to the important areas in the east, west and south of England, and large tracts of country interspersed among the industrial areas where there was no supply of electricity, and he advocated the formation of small local companies for the supply of electricity, controlled by central companies. Another and more promising method of affording electricity supply to scattered districts was where electricity works could be combined with a gas undertaking. In East Anglia, he believed, there were more of these "unoccupied areas" than anywhere else in the country. In Essex he mentioned Shenfield, Hutton, and Brentwood, Harwich, Dovercourt, and Parkeston. He had good reason to believe that in twelve months steps would be taken to develop these areas, which were likely to prove remunerative to carefully-managed electricity companies.

In the design of radio-station towers and masts, the maximum wind pressure and the law connecting the pressure with the height above the ground are of primary importance. Mr. C. F. Elwell, in a recent paper before the Wireless Section of the Institution of Electrical Engineers, reviewed briefly the results of past experiments, and endeavoured to point out what are safe and economic values of wind pressure for design purposes. The need for the standardisation of wind-pressure assumptions is also emphasised. The variety of specifications employed in the past shows that a considerable difference of opinion exists, i.e., from 15 lb. to 112 lb. per square foot. In radio mast and tower design the load due to the wind is the chief load. Masts when unloaded are held vertical and designed to lie in a straight line, or as an arc of a circle when fully loaded. A wrongful assumption as to wind-pressure distribution from the top of the structure to the bottom can readily upset the designer's calculations as to the position which the mast will take up in a gale.

Calorising is the term used to denote the formation of a surface alloy of aluminium on ferrous and non-ferrous metals: this is achieved by placing the articles to be treated in an air-tight retort, partly filled with the calorising mixture—which consists of finely divided metallic aluminium suspended in aluminium oxide—and subjecting it to a high temperature for several hours. During the process, a continuous current of hydrogen is passed through the retort to ensure an inert atmosphere. Before being placed in the retort the articles are required to be thoroughly cleaned and to have a surface free from grease, scale or other foreign matter, this being effected either by sand-blasting or pickling. The treatment, conducted at high temperature, so thoroughly infuses aluminium into the exposed portion of the metal being treated as to form a homogeneous alloy for a depth which ranges from a few thousandths of an inch to the permeation of the entire mass, and is governed by varying the duration of the treatment and the composition of the mixture.

The results of tests of a large boiler fired with powdered coal have been published by the American Bureau of Mines. The boiler tested has 13,380 square feet of heating surface, and is equipped with the Lopulco powdered coal system. Twenty-six tests were run at rates of heat transference varying from 4000 to 8000 B.Th.U. per square foot of boiler heating surface, and the mean thermal efficiency attained was about 84 per cent., based on the gross calorific value of the fuel as fired. The efficiency varied little with the rate of steaming, and its high value is accounted for by the small loss from incomplete combustion and the small amount of excess air, which varied from 5 to 36 per cent. The coal burned had a gross calorific value of about 11,500 to 12,800 B.Th.U. per pound, contained 2 to 5 per cent. moisture, 33 to 36 per cent. volatile matter, and 9 to 13 per cent. ash, and was so ground that 80 to 95 per cent. would pass through a 100-mesh sieve. The ash had a softening point of 2150 deg. to 2450 deg. Fah., but did not fuse together at the bottom of the furnace because it was partly protected from the flame radiation by means of a series of water tubes connected to the boiler, which were placed between the furnace bottom and the flame.

## Miscellanea.

It is understood that the possibilities of working tram extensions in Madras by means of gas engines are being examined by the Electric Tramways Company.

The casting of metal bath and lavatory fittings is the latest adaptation of stainless steel to articles of common use, and this advance opens up an important field for the exploitation of the material.

The United States output of pig iron in January was 3,229,600 tons, the highest output since March, 1920, with the exception of October in that year. The January production of steel was 3,716,200 tons, a figure higher than for any month since March, 1920.

The borings over the Tyrone coalfield at Coalisland have reached an excellent household coal at a depth of 850ft., and another seam at 1000ft. The latest seam tapped has a thickness of at least 6ft., while there are several intervening ones of from a few inches to 2ft. in thickness.

It is announced that negotiations between the Dolcoath Mine, Limited, and the Trade Facilities Act Advisory Committee have at last been completed. The amount of the Government guarantee has been increased to £65,000, leaving £55,000 to be found by shareholders, instead of £50,000 and £70,000 respectively.

The Boilermakers' Union in New South Wales has decided to lift the restrictions which it imposed some months ago on the use of pneumatic machines for repair work. The machines were objected to on the ground that their use was calculated to aggravate unemployment. The restriction on the use of the riveters had resulted in a lowering of the standard of working methods.

Approximately 70 per cent. of the excavations for the new Durban graving dock and 50 per cent. of the concreting work are completed. The side walls, as wellas the return walls at the entrance, are practically completed to coping level. Advantage will be taken of the opportunity to reclaim 137½ acres of low-lying land intervening between Maydon Wharf extension and the graving dock by pumping spoil recovered from the channel approach ashore.

The Queensland Irrigation Commission has decided to commence work on the Dawson River irrigation scheme. The dam site is situated 35 miles from Taroom and 180 miles inland, lying due west from Maryborough and 60 miles from railhead at Juandah. The catchment above the site is approximately 9000 square miles in extent, and the reservoir will contain about 234,500 acre feet. The available storage, it appears, will be sufficient to irrigate the whole 200,000 acres.

The electric power generating plant of the Cardiff Collieries, Limited, is practically completed, according to the *Iron and Coal Trades Review*, and the directors have decided to sink a new pit to the Little Rock Seam, which is of good section and of coking quality. An electrically driven winding engine for the new pit has been delivered, and preparations are now being made for its erection and that of the permanent head frame, after which sinking operations will begin.

It is reported in the *Soir* that an aeroplane construction industry is to be started at Zeebrugge. Land and sea gliders and seaplanes will be the first types of machines to be constructed, the first two being designed for sporting purposes and the third for employment in a service between the Belgian and English coasts, such service being designed to carry tourists to and fro at popular fares. The question of turning Zeebrugge into a base for seaplanes and submarines, which would act as a Belgian coastal defence service, is being seriously contemplated.

At the annual general meeting of the National Federation of Iron and Steel Manufacturers, held recently, the thanks of the Federation were expressed to Mr. John Craig, (the chairman and managing director of Messrs. David Colville and Sons, Limited), the retiring President, for his services to the Federation during the past year. Mr. Arthur Dorman (Messrs. Dorman, Long and Co., Limited) was elected President for the ensuing year, Mr. C. E. Lloyd, (Messrs. N. Hingley and Sons, Limited) and Mr. Albert Peech (the chairman of United Steel Companies, Limited) Vice-presidents, and Mr. Edward Steer (chairman of Messrs. Guest, Keen and Nettlefolds, Limited) was elected a Vice-president in place of Mr. Arthur Dorman, elected President.

The naval wireless expert who inspected the wireless station in Colombo at the request of the Ceylon Government, has, according to *Indian Engineering*, submitted a report wholly condemning the station, which, he says, is out of date and incapable of coping with the traffic with which it has to deal. As a result of this report, the Government of Ceylon has ordered the apparatus necessary to provide for continuous wave working, by the use of which it is hoped that the range of the station will be improved and the screening effects at present experienced reduced. A new receiving set, with an amplifier, additional transmitting and rectifying valves which will allow utilisation of the maximum power available at the generator, and a new balanced earth system designed to improve the efficiency of transmission and minimise screening effects are to be added.

The Postmaster-General has drawn the attention of architects and all engaged in the building industry to the importance of making adequate provision for telephone service in the construction of large buildings, in order to eliminate the necessity of costly alterations later on. Complaints, he says, are sometimes made by the owners of lessees of new buildings of the inevitable interference with the structure and decorations caused in providing telephone wiring and equipment, while occupiers complain of the disturbance occasioned by the piercing of walls and floors, and applicants for services complain of the delay which sometimes occurs in meeting their requirements. He points out that the cost of the installation is also increased if the provision he suggests be not made, and that by the exercise of a little precision all these causes of friction might be avoided.

# THE STADIUM IN WEMBLEY PARK

MESSRS. JOHN W. SIMPSON AND MAXWELL AYRTON, ARCHITECTS, AND MR. E. O. WILLIAMS, ENGINEER

(*For description see page 358*)

FIG. 10—THE SOUTH ROOF UNDER CONSTRUCTION, FROM THE EAST

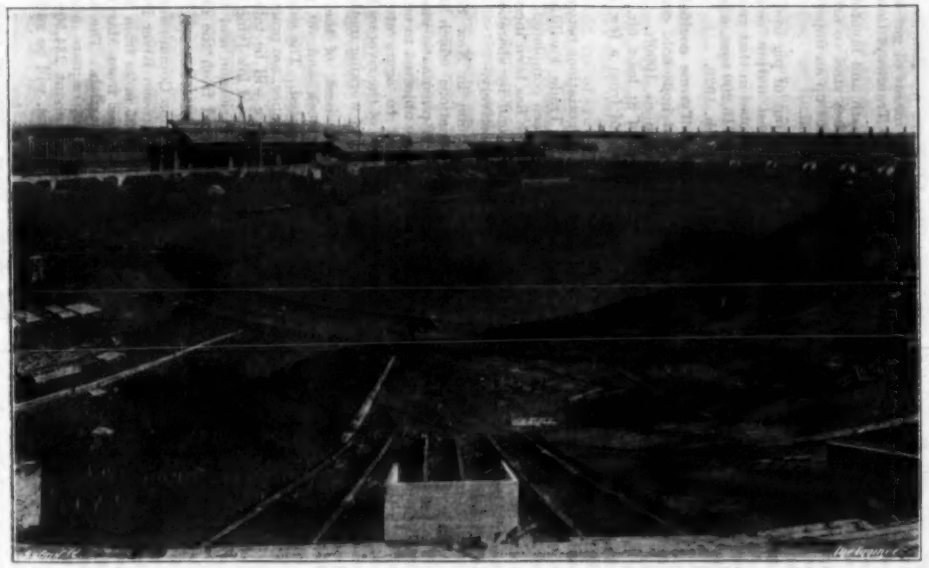

FIG. 11—GENERAL VIEW INSIDE STADIUM DURING CONSTRUCTION, FROM THE SOUTH-WEST

FIG. 12—THE STEEL WORK OF THE SOUTH ROOF, FROM THE WEST

FIG. 13—THE SOUTH ROOF NEARLY COMPLETED, FROM THE WEST

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**DEATH.**

On April 3rd, at a private nursing home, John R. R. Wilson, M. Inst. C.E., H.M. Divisional Inspector of Mines, of 4, Park-terrace, Newcastle-on-Tyne.

# THE ENGINEER.

*APRIL* 6, 1923.

### French Naval Statute.

The "naval statute" in France is a scheme embracing a wide policy of organisation and construction, of which the result is to provide a homogeneous fleet capable of carrying out certain well-defined objects. The previous "statute" was prepared by the late M. Delcassé, and was interrupted by the mobilisation of 1914, which put the navy entirely in the background, and as the termination of the war left France with a sadly diminished fleet of little value, the question arose of creating an entirely new navy in accordance with the changed conditions of naval defence. In the years immediately following the Armistice the international situation lacked elements upon which to establish the basis of a future policy. The destruction of the only naval power which threatened the security of France removed the necessity of organising a coast defence, especially in view of the proposals then put forward for a "pact of guarantee." Nevertheless, opinion in France has never been in favour of relying upon others for protection, and the construction of a sufficiently powerful navy continued to be the background of national politics, as was shown by the claims put forward by the French delegates at the Washington Conference. It must be admitted that the signing of the Treaty did not meet with unmixed approval in France, where its presentation to Parliament was delayed until the Conseil Supérieur de la Marine had settled upon the main lines of the "naval statute." There seems to be little doubt that the Washington Treaty will be ratified with certain reservations, notably in providing greater latitude for the withdrawal of France in case of emergency. It is argued that the country cannot allow itself to be bound down by limitations which may affect the national security. The whole question has, therefore, developed much larger issues than were presented at the time of the Washington Conference, when it was urged that the French naval policy aimed merely at an efficient coast defence and the guarding of a seaway between France and North Africa with the aid of submarines and fast cruisers.

That policy certainly underlies the first part of the programme of naval construction which was begun recently. A beginning had to be made with the most necessary and least costly types of craft, consisting of three fast unprotected cruisers, six destroyers, twelve torpedo boats and six sea-going submarines. This short programme is to be extended by a second instalment of constructions from 1925 to 1930, and the list of vessels in the proposal which has just been submitted to the Chamber of Deputies comprises six light cruisers, fifteen destroyers, twenty-four torpedo boats, four "cruiser submarines," thirty first-class submarines, two mine-layers and four oil transports. For the moment the French are concentrating upon the submarines and light surface craft authorised by the Treaty and forming part of the defensive organisation which will be completed by an air service in conjunction with seaplane carriers and an unrestricted number of small submarines for coast protection. The submarine has always cast a spell over French public opinion, which exerts a powerful influence upon the decisions of the Government departments. Public opinion is by no means satisfied with the limited character of the submarine programme, and there will certainly be a lengthy debate on the restrictions imposed by the Treaty on sea-going submarines when the "naval statute" comes up for discussion. Consequently, the purely defensive policy is already assuming the offensive, and while having the right to build as many light under-water craft as they please for coastal operations, our French friends will not submit without protest to any considerable limitation of sea-going submarines. On the other hand, the Conseil Supécieur de la Marine has never been willing to sacrifice capital ships to under-water vessels, and the arguments against a complete dependence on submarines have only been partially modified by the association of submarines with seaplane carriers, whereby the submarine will be given a wide range of vision. Still, submarines are neither able to navigate at the speed of surface ships, nor to attack in formation under water. Consequently, they suffer from limitations which render it undesirable to sacrifice large surface vessels.

In the first two instalments of the naval programme no provision is made for the construction of capital ships. That omission is partly due to the limited financial resources and, more especially, to the belief that it is wise to wait for further battleship developments before deciding upon a definite type. In any case, it is not likely that new capital ships will be constructed before 1930, by which time some of the existing ships will be dismantled and full advantage will be taken of the 177,800 tons allotted by the Washington Treaty to create a homogeneous and entirely up-to-date fleet. The situation, therefore, is fairly clear, and will not be considerably modified by the forthcoming debate in the Chamber of Deputies. In the present state of finances the country must do the best with its expenditure, and it considers the only possible plan to be to build submarines, light surface ships and aircraft, but the programme now comprising "cruiser submarines" accompanied by seaplane carriers will be completed eventually by a number of new capital ships. The programme itself is not dependent upon the ratification of the Washington Treaty, for in the improbable event of Parliament insisting upon reservations which the other signatory Powers could not accept, the programme would be extended as circumstances required. It is affirmed that efforts will be made to make a ratification of the Washington Treaty conditional on the Versailles Treaty being carried out in its entirety. If this be, indeed, the case, complications may arise that will endanger the agreement which has been come to amongst the leading Powers for a limitation of naval armaments.

### The Railways' Opportunity.

When speaking at the Federation of British Industries luncheon in Manchester last Tuesday week, Sir Eric Geddes, quite justly, took credit to himself for having advised the late Government not to adopt the policy of nationalising the railways. He then alluded to the benefits wrought by the Railways Act, and, in particular, to the arrangements made therein for the settlement of labour questions. He said that, from a reply given by Sir Colonel Wilfred Ashley, they learned that the machinery thus set up had had the effect of reducing the railway wages bill by no less than fifty-three millions a year, without strikes, without disputes and without dislocation. "If ever," Sir Eric added, "there was an example of what could be done by discussion and reason rather than by the arbitrament of force, this was one of which we, as a country, might justly be proud, and, from all he could learn, the machinery was appreciated by all three parties concerned—railways, employees, and users."

The speaker, we noticed, took no credit for this

machinery and, again, quite rightly. Indeed, we feel sure that these happy results would not have been possible had Sir Eric's original intentions in this matter been adopted. He, it will be remembered, wished the men to sit on the management. Had that proposal been sanctioned, we should have been faced by a position that would have led to constant friction between the companies and the men. The latter evidently saw its weakness, and they accepted in its place the companies' proposals which, it is important to note, are exactly those now so generously praised by the late Minister of Transport. Another idea of Sir Eric's was the segregation of the Scottish companies. These companies wished to be amalgamated with their respective English colleagues so as to make two continuous companies, but whilst the English railways were not enthusiastic over the proposal, their spokesmen in committee proposed an amendment to meet the wishes of the Scottish companies. It was, as every one knows, adopted, no doubt, for the railways' common good. Another feature of Sir Eric's programme, and one which was unquestionably premature and extravagant, was to scrap all existing wagons in favour of a standard high capacity freight car. At Manchester, in the speech to which we have already alluded, he said he had no reason to alter the opinion he held when the Railways Bill was under discussion that at least twenty-five millions a year could be saved—not immediately, but when full effect had been given to grouping. We take this statement to mean that, independently of lower wages consequent upon a reduction in the cost of living and independently also of a lower price for materials, Sir Eric anticipates that there will be, as a result of the grouping of the railways, a saving of twenty-five millions a year in administration. Candidly, we do not believe it. The economies effected by huge amalgamations are generally illusory, and we shall be greatly surprised if the grouped railways succeed in reducing expenditure—assuming as progressive a service as the independent companies would have given—below that which would have been made under the old method. A saving of twenty-five millions means a cut of one-third of the pre-war expenditure and of about one-sixth of that of to-day. There will, it is true, be an economy in directors' fees and in the salaries of secretaries and other head-office expenses, but all the "general charges" put together for British railways in 1921 did not amount to six millions. In other administrative spheres officers have been dispensed with, but those that remain have had greater responsibilities thrust upon them, and for these they are being paid higher salaries, and we have no manner of doubt that, following the familiar course, what is saved in big sums will be exceeded by the salaries and wages in the lower ranks. Further on in his speech Sir Eric said that the Federation of British Industries was pressing for rates—now at about 75 per cent. above pre-war level—to be reduced to 33⅓ per cent. above that datum. On this point we have a suggestion to make. It will be remembered that during the control period, owing to scarcity of labour and material, the repairs and renewal of the road and rolling stock did not receive their usual attention. The companies represented that these deficiencies would have to be made good later, and, further, that it was not right that the savings resulting from the postponement of the work should go towards reducing the Government's railway costs at the future expense of the companies. The Government concurred and began paying, month by month, sums for "arrears of maintenance and renewal," which the companies placed to a special reserve. Only a portion of these arrears was paid at the time and, over and above the balance due, there were charges for "extra wear and tear." It was in settlement of all claims for arrears and for extra wear and tear that the Railways Act voted sixty million pounds. This sum is always termed "compensation," but, technically, it is rather a settlement than compensation. Now, it is generally acknowledged that the physical condition of the railways has been brought up to the pre-war standard. That being so the amounts standing in the companies' balance sheets for arrears of maintenance and renewal, and those under the misleading title of "Compensation under Railways Act," are not required for their original purpose. For the seventeen principal companies, they amounted, at the end of 1922, to forty-five million pounds for arrears, and fifty-two million pounds for compensation, or, allowing for the interest being earned, a total in round numbers of about one hundred million pounds.

Out of the one hundred and sixty-eight millions expended last year on railway working by these seventeen companies, only fifty-two millions went in maintenance and renewal of road and rolling stock—roughly, one-half on labour and one-half on material. The suggestion, which we put forward is that this sum of one hundred million pounds should, for the next ten years or more, be devoted to its legitimate use, and thus reduce the cost of upkeep. Ten millions a year would be equivalent to a saving of 20 per cent. and ought to allow for a big reduction in rates. Such a reduction is most desirable in the companies' own interest. It would increase their traffic, reduce the cost of their materials and stores, lower the cost of living, and, concurrently, their own wages bill, and, above all, put them right with their men when discussing the proposed modifications in the conditions of service.

## The Present Status of Sewage Treatment in England.

In January of this year Mr. George W. Fuller, the eminent consulting engineer of New York, paid a visit to this country with the specific object of inspecting a selection of the sewage disposal works and of having interviews with British specialists in sanitary engineering. Since he got home he has set down the results of his observations, and they have been published in three successive issues of our contemporary, the *Engineering News-Record*, the editor of which has courteously drawn our attention to them. Now what Mr. Fuller has got to say is always worth listening to. He is a leading authority in sanitary engineering in America, and his book on "Sewage Disposal" is well known in this country. We feel sure therefore that a *résumé* of what he has written concerning our works will be of interest to our readers.

Mr. Fuller was not here long; indeed, he speaks of his visit only having lasted two weeks. But he certainly appears to have seen a great deal in the time, and his report upon it all is set out with conciseness and lucidity. After some preliminary remarks, in which he shows how severely our sewage works were handicapped as the result of the war, he treats his subject under three headings:—I., Administration and Policy Questions; II., Status of Older Types of Treatment; and III., Outlook for the Activated Sludge Method.

### Administration and Policy Questions.

Under this heading Mr. Fuller states that, as a first step towards getting sewage works back on a fairly satisfactory basis of performance, local administrations have dealt with means for overcoming the abnormal amount of deferred maintenance incident to war-time interruptions. The principal undertaking has been, he says, to wash and restore clogged filter beds, which has involved contact beds, apparently of all kinds and sizes of materials, and also sprinkler or percolating beds of comparatively fine material. "Just where to draw the line as to size of material in sprinkler beds which have been in service for fifteen to twenty years without clogging, and those which have become seriously clogged, is not," he remarks, "a simple matter. But I should judge that little or no clogging of a permanent nature, due to sewage solids, has occurred in beds where the material was freed from particles passing a ¾in. screen."

A second feature of local policy has been, it is pointed out, to make use of existing works so far as was advantageously practicable. This step is shown by the general practice of installing activated sludge plants in existing tanks or beds; by the conversion of contact beds to sprinkler beds; and by the substitution in the latter of coarse as compared with fine material, and the addition of humus tanks, which are needed to follow beds of the former, but not of the latter type. Pursuing the same subject and under the sub-heading "Results Commensurate with Cost," Mr. Fuller writes as follows:—"In all countries and at all times engineers have sought and should seek the adoption of works and methods that will give results commensurate with their cost. In England to-day, with its heavy tax burdens, it seems to me that more than ordinary attention is being given to this question of policy. Presumably, it explains why some managers are making haste slowly in re-vamping existing works so that they may investigate new developments, such as the activated sludge method; and thus allow themselves to come to a satisfactory conclusion as to whether a given performance of sewage treatment, in point of quantity and quality, can be more economically secured by reconditioning existing works or by installing new ones. Certainly this performance-commensurate-with-cost policy explains why the time-honoured method of chemical precipitation has given place completely and, I believe, permanently to plain sedimentation."

It is interesting to note that visits to ten or a dozen sewage works in this country led Mr. Fuller to take the view that they were well equipped with good mechanical appliances for indicating and recording needed quantity data, as well as with good laboratory facilities, "such as have characterised good English sewage works for many years." "In America," he continues, "there are some sewage plants where daily records are excellently kept, but, generally speaking, I doubt if these records compare favourably with those secured by the managers of corresponding English sewage works."

With regard to our River and Conservancy Boards, Mr. Fuller gives it as his opinion that they constitute one of the sanest and most efficient factors of the English system for the control of river pollution. "They provide decentralisation to the extent of putting administrative authority into the hands of a local resident agency, constituted of representatives from city, borough, county and private business interests. And yet the Board comes in no way in conflict with the central authority, with whom it can co-operate to mutual advantage. It can act as an effective whip on the town authorities. In particular does it effect co-operation with, rather than opposition from, the owners of mills and other private business establishments. While such District Boards cannot hope to bring about the elimination of all objectionable pollution in a large valley in the course of a very few years, for financial if for no other reasons, yet they constitute, in my opinion, the most rational basis of procedure yet devised for steadily bringing about the progressive installation of important works, involving the expenditure of substantial sums of money by a municipality of public and private interests."

### The Status of Older Types of Treatment.

Under this heading Mr. Fuller, first of all, directs attention to the fact that practically all sewerage systems in England are built on the combined system and that the dry-weather flow—d.w.f.—usually ranges from 30 to 50 United States gallons per capita per twenty-four hours. During storms, he points out, the authorities require that 3 × d.w.f. shall be treated as sewage, and that flows from 3 to 6 × d.w.f. shall be treated as storm water. He also draws attention to the presence of trade wastes in the sewage in many of our cities and towns, and discusses the possible effects of these "foreign" fluids. Turning then to detritus tanks, he states that the English seldom use grit chambers of the form used in America, where the mineral matter is separated in a series of channels at a velocity of 8in. to 12in. per second during a flow of from 60ft. to 100ft. "Instead," he says, "they install tanks holding 1/100 to 1/12 d.w.f., with little or no regard to velocity through them. The purpose is to deposit the bulk of the coarser solids where they can be readily and frequently removed by grab buckets or otherwise, without disturbing the regimen of the main tanks, or increasing the cost of sludging the latter. This programme is negotiable in England where all sludge is ordinarily disposed of by barging to sea, pressing, lagooning or trenching on land. But these tanks afford a much greater clarification for the effluent of the detritus tanks than is the case with grit chamber effluents in America. Here is a factor which lessens to a substantial extent the apparent difference between the suspended matter in England and American sewages, due to different volumes of sewage per capita."

So far as is known, Mr. Fuller remarks, chemicals are not now used at any works to promote the deposition of solids in town sewage. During the war precipitants were not procurable; now, their benefits are not considered commensurate with their cost. The effluent from detritus tanks is subjected to plain sedimentation in open tanks, with floors having a slope of about 1 per cent. Sizes vary, but several good designs show the capacity to be fifteen to eighteen hours in times of dry-weather flow, thus providing five to six hours for the storm sewage of 3 × d.w.f.

With regard to septic tanks, Mr. Fuller writes as follows:—"At only a few large works do tanks seem to be employed as formerly to serve jointly the purposes of clarification of the sewage and the digestion of the sludge. The open septic tank seems to have largely disappeared, partly because of air nuisance and partly because the managers desire a more uniform, convenient and economical programme for sludge removal than is permitted by such tank operation. No new projects contemplate septic tanks, so far as known."

After remarking that he saw no signs of any new installations of either Travis or Imhoff tanks, of which there were three or four installations of each prior to the war, and referring in turn to separate sludge digestion, sludge barging, sludge lagooning, sludge trenching and sludge pressing, Mr. Fuller continues, under the sub-heading "Sludge Utilisation":—"The outstanding experience in England in this field is that of Garfield at Bradford. During the war he sold annually about £150,000 sterling of grease, of which sum perhaps £50,000 was net. Now the market is poor, but he is producing 20 to 25 tons daily of 98 per cent. grease, which in limited quantities can be sold for £8 10s. per ton. This is nearly down to pre-war prices, although labour and supplies for production are nearly double. Before the war he was selling much pressed sludge cake with about 2 per cent. nitrogen content to France, but transportation charges have killed that enterprise. I was interested to note that he was running his own boiler plant with dried sludge cake and melted grease (?)"

Contact beds Mr. Fuller describes as not being

"entitled to the standing they had twenty or even ten years ago," the reasons being, he explains, that their total cost is too much for the work done, and that they are relatively unadaptable to increased loadings at times of storm flows. Sprinkler beds, he says, "have shown an excellent record in England. The beds of coarser material have shown no signs of serious clogging, and those of fine material have a better record than contact beds. During storm flow the English sprinkler beds seem to work satisfactorily at double the dry-weather flow or double the maximum daily rate of dry-weather flow. . . . While spray jets have not been given up, it is noteworthy that travelling distributors are being installed at most of the new works." Of the sprinkler bed, by the way, it is said that "as a fool-proof arrangement . . . (it) is entitled to the highest rating."

Mention is made of an activated sludge plant to be installed at Minworth to treat the influent of the sprinkler beds, so as to remove colloidal matters, and to put the filter influent on an oxidising basis at all times. Reference is also made to the 60 acres of filters which Mr. Garfield is laying down at Bradford, which are to be 6ft. deep and filled with fine coal, say, ½ to ¼. These beds, it is recognised, will clog sooner or later, but instead of washing the clogged material, Mr. Garfield proposes to burn it and fill up the beds with new coal. He will thus, in effect, create additional coal storage space.

### Outlook for the Activated Sludge Process.

"On English evidence alone, this method," says Mr. Fuller, "has come to stay, with a certainty that more and better data concerning it will be available year after year. . . . The scientific basis on which this biological process is founded is undoubtedly sound, regardless of the limitations which its practical application may encounter." The observation is made in one place that "before aeration, English sewages are clarified to a much greater extent than in America," but in another place it is remarked, on the other hand, that "clarified English sewage more nearly compares with American sewages before aeration than one might suppose." At none of the plants visited was nitrification of the effluent sought or obtained, except at Tunstall, though the reservation is made that the Worcester data were not to hand when Mr. Fuller wrote his articles. The absence is attributed to trade wastes, as nitrification is said to appear during holidays. "The settled effluent," continues Mr. Fuller, "is clear and stable. Non-putrescibility seems to be due partly to oxygenation, but principally to the successful removal of colloidal matter. I surmise that the separation of colloids from the more concentrated English sewages may come about rather more readily than in the case of the weaker American sewages. Perhaps the influence of iron salts is a greater factor than generally realised. However, the coagulating capacity of the returned activated sludge seems in some cases to be more of a factor than is generally regarded as the case in America."

The methods of mechanical aeration practised by Mr. Haworth at Sheffield and Mr. Bolton at Bury are described, and the comment is made that there is between "air diffusion" and "mechanical circulation" considerable competition, which is reminiscent of the "more or less similar discussions I noted during a visit to England in 1900 as between contact beds and percolating filters." And again: ". . . The owners of patents associated with the air diffusion devices and method now face competition from two types of mechanical circulation appliances, of which one is patented and the other not. Such a situation stimulates interest and discussion, but over-promotion easily leads to exploitation which is usually disastrous to all concerned. Competition within reasonable limits is helpful, and I doubt if experienced engineers begrudge reasonable overhead expenses to promoters and sellers of patented arrangements. The programme as to the status of patents on the activated sludge method does not seem to have become fully matured, and development will be watched with keen interest. This is particularly true of American engineers who have followed during the past twenty-five years the course of such patented arrangements as the Cameron septic tank, the Imhoff tank, the mechanical or rapid sand water filters, to say nothing of more recent proprietary devices for sewage treatment." As regards air consumption, Mr. Fuller found that both at Worcester and Tunstall about 1 cubic foot per Imperial gallon was needed, whereas at Manchester the average figure is 1.4 cubic foot, though on one occasion he noted a consumption at Davyhulme of only 0.5 cubic foot to the gallon.

The various methods of disposing of the sludge are briefly discussed, and it is recorded that the excess sludge at most English plants of the activated sludge type is mixed with other sludge produced at the works, "and so the issue *per se* has been faced in only a limited way." Mr. Fuller also states that "at Manchester, Sheffield and some other places studies have been made on dewatering the sludge by vacuum filters and dryers, but I doubt if available English data approach in extent those obtained at Milwaukee, Chicago and Houston. The English have done enough to realise the difficulty of dewatering activated sludge which may behave quite differently depending upon varying composition, both chemically and biologically."

Finally, as regards efficiency and cost, Mr. Fuller concludes as follows:—"There is no doubt about the capacity of this process to turn out a stable, clear effluent, without air nuisances in the neighbourhood. Its installation cost is attractive to the English, as it is less, apparently, at some places than that of revamping existing works. Operating costs vary. They are stated as ranging at some places from £2 to £2 10s. per million gallons for a 1,000,000-gallon installation, with power costing 7d. (?) per kilowatt-hour."

THE DIPPER DREDGER RUSSELL AT WORK ON THE RIVER YARE

## Dipper Dredger for the River Yare.

In 1912 the engineer of the River Yare Commissioners, Mr. Arthur E. Collins, M. Inst. C.E.—who is also the city engineer of Norwich—visited Canada and the United States, one of his objects being to study river-dredging equipments. This he did on the St. Lawrence and elsewhere, and, as a result, he decided that the dipper and spud dredger was best suited to the requirements of the Yare, and chose that designed and patented by Mr. A. W. Robinson, M. Inst. C.E., of Montreal, as being the best of its class.

Mr. Collins immediately entered upon negotiations for a set of machinery to be supplied for erection on a hull which he proposed to build himself, but the financial limitations of the Commissioners and later the war, stopped the enterprise for the time being, and when negotiations were renewed, it was found that Mr. Robinson had arranged with Lobnitz and Co., Limited, to build his patented dredgers at Renfrew. A contract was thereupon entered into between the Commissioners and Messrs. Lobnitz for a dredger to suit the Yare and its tributaries, Bure and Waveney.

This dredger, which is named the Russell, after Mr. Russell J. Colman, chairman of the Commissioners, and which is illustrated in the accompanying engraving, has recently been completed and had its trial runs with exceedingly satisfactory results, dredging and depositing ashore being effected at exceedingly low costs. She is, we believe, the first dipper and spud dredger to be set to work in this country.

The hull consists of a rectangular pontoon 72ft. long by 20ft. breadth moulded, by 5ft. 6in. depth moulded, upon the deck of which is the machinery, the boiler being in a well near the stern. The dredging gear, which is arranged at the bow consists of a steam navvy with a very long dipper or shovel arm, the jib or boom top centre being held by a pair of sheer legs. As the Russell has to pass small bridges, viz., Bishop Bridge, Norwich, the Acle Bridge and others, her dimensions had to be limited but, notwithstanding that, she is fitted with a 1¼ yard dipper or shovel, the operating cycle of which is nominally one minute. In straightforward work it often, so we gather, attains a speed of a cycle in 45 seconds.

The vessel dredges to 17ft. 6in. deep for a width of 30ft. from her centre, and deposits ashore or into lighters at 40ft. from her centre and 17ft. above water line. When depositing into lighters she can dredge a channel 60ft. wide at one passage. When depositing ashore this width is usually limited to avoid damage to the river banks. She is held to her work by spuds, there being one on each side at the bow, and a third at the centre of the stern. Hence she requires no hawsers to hold her, which is of great advantage as leaving an unobstructed passageway to navigation. The spuds are rectangular steel booms about 31ft. long. Those at the bow slide vertically in recesses in the sides of hull, and are lifted or lowered by steel ropes controlled by capstans. They can be forced into the river bottom to such an extent as to lift the pontoon and cause it to be a stationary platform for dredging operations. The stern spud, in addition to its vertical sliding motion, is mounted on a pivot so as to have a forward and aft swinging or striding motion. Its duty is to hold the dredger in line, and it is not used for taking weight.

The Russell has no propelling machinery, but she can be manœuvred to and follow up her work by the spuds and dipper in the following manner:—For straightforward advance the dipper and the stern spud are dropped to the bottom in their forward positions, the bow spuds being drawn clear of the bottom. The dipper arm is then hauled astern, and the craft goes ahead, being held in her new position by hauling down the bow spuds into the river bottom. By modified uses of the spuds and dipper corners can be turned, &c.

In many parts of the Yare soft mud to great depths is found, and, to assist the vessel in standing on it, hinged flaps or tables, which largely increase the bearing area, are fitted to the bottom of bow spuds.

Russell was built at Renfrew, and was then dismantled and sent to Norwich, where she was rebuilt by her crew—selected by Mr. Collins—the hull being launched in sections and fastened together when afloat.

We are asked to state that the River Yare Commissioners would welcome visits to the vessel from engineers or authorities responsible for dredging, they being of opinion that such efficient, economical plant should be well known. A letter to their engineer, Mr. Arthur E. Collins, Guildhall, Norwich, will ensure information as to where Russell is at work and how to reach the spot.

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Writing on chimneys for chemical works, in *Industrial and Engineering Chemistry*, Mr. T. S. Clark recommends that the top of a chimney handling acid fumes should be protected with a cap, covering both the lining and the main walls, and made of material not affected by the particular kind of acid under consideration. Ample room should be allowed for the lining to expand upward and outward. Furthermore, the cap should be so designed that no dust, fumes, or moisture can find their way down between the main walls and the lining. With certain acid conditions the cap may be made of lead. With other acid conditions a cap of Monel metal has been used with success. Where lightning rods are installed on acid chimneys, the upper 50ft. or more of the complete rod should be covered with an armour to protect the copper from the effects of the acid. Lead covering is in most cases effective. All chimneys handling acid gases should be equipped with an outside ladder, the upper portion of which should be covered with lead or an acid-resisting material.

## A Turbo Gas Booster.

We recently had the opportunity of attending the running trials of a turbo gas booster, built by Reavell and Company, of Ipswich, for the Bournemouth Gas and Water Company. The plant—which we illustrate in Fig. 1—is installed at the Poole gasworks for the purpose of delivering gas from that works to the Bourne Valley gasholders in Bournemouth, a distance of some 6500 yards. The gas main has a diameter of 24in., and the booster is designed to deal with 360,000 cubic feet of gas per hour at a delivery pressure of 42in. water gauge, the gas having a specific gravity of 0.55. The horse-power required is

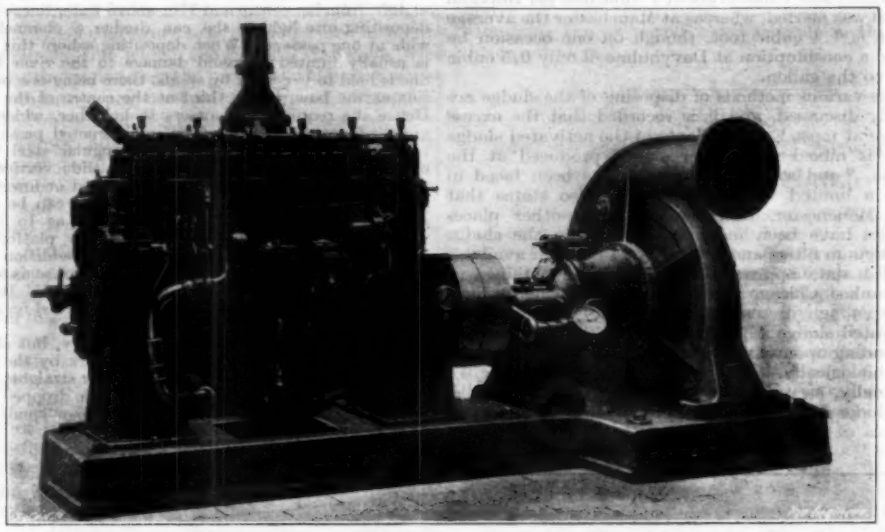

FIG. 1—TURBO GAS BOOSTER FOR POOLE GASWORKS

about 60, and the power is furnished by a six-cylinder high-speed vertical gas engine, built by the National Gas Engine Company, Limited, which is designed to develop 65 horse-power at a speed of 800 revolutions per minute. The engine itself is shown in the illustration—reproduced in Fig. 2—and a detailed account of it was given in The Engineer of April 6th, 1917.

The most interesting feature of the installation is the Matteucci patented speed transmission gear, which is built on to the booster volute casing, and is shown in section in the drawing on page. 373. As will be noted from the general arrangement of the plant—see Fig. 1—the engine and booster with the speed transmission gear are mounted on a common bed-plate with a flexible coupling interposed between them. The booster is a single stage machine with the impeller running to 3600 revolutions per minute in a volute casing having a 16in. diameter suction branch and discharging to the 24in. main through a 12in. delivery pipe.

The Matteucci gear for which Reavell and Company, Limited, have obtained the manufacturing rights, was first used as a motor lorry clutch, and gave, we understand, excellent results on difficult roads during the Trentino War campaign of the Italian Army. The present application is a new one, and its success opens up further possibilities of development, both as a speed increasing and reducing gear.

The gear is of the positive reaction type, and rollers, working on the sun and planet system, are employed to bring about the desired change of speed, which in the design we are now considering is from 800 to 3600 revolutions per minute. The working of the gear may be followed with the help of the sectional elevation of it given in the drawing.

A low speed shaft of the gear A is connected to the gas engine by the flexible coupling, and on the shaft is fitted a cage B. This cage is the medium through which the planetary rollers C are driven, the cage being furnished with prongs of a kidney shape, which are trepanned out of it. On these prongs are fitted the five planetary rollers C, which revolve inside the outer race E of the gear.

The outer surface of the race E is coned and fits accurately into the main casing F. As will be seen from right-hand end section the race E is split in a diagonal direction after the manner of a piston ring. When drawn into the casing in an axial direction, the race tends to close in, and in so doing grips the satellites and the central roller with considerable radial force.

The central roller G is formed on the high-speed shaft of the turbo booster, and thus the revolving cage causes the centre shaft to move with a high speed of rotation because the periphery of the central roller has the same speed as the periphery of the satellites.

The axial force which is required to give the necessary radial grip is obtained by means of the compression spring H, which, acting through the lever J moving on a ball fulcrum K fixed on the casing, transmits an axial pull to the outer race E, drawing it into the coned casing.

The force is applied at a point L on the shaft centre line, by means of the forked lever J, which presses on the collar M and transmits the pull through the sleeve to the ball race N, and the intermediate member O to the split race. The spring is provided with means for adjusting the pressure to suit different loads.

In a gear of this type lubrication and cooling both play an important part in achieving reliable operation over prolonged periods. Referring to the prongs of the cage, it may be pointed out that the diameter of these prongs is sensibly less than the bore of the rollers which they drive. The result is that a wedging action takes place on the lubricating oil which is caught between the prongs and the inner bore of the rollers. This action, which is not unlike that of the Michell thrust gear, is very conducive to silent and smooth running and freedom from internal wear.

It being essential that a reasonable quantity of lubricating oil reaches the inside of the rollers, the prongs are provided with oil channels which are fed by means of an oil ring dipping into the oil well and raising oil to the top of the shaft, from whence it passes through the main bearing bush to the cage oil grooves. Another ring lubricates the outer main bearing bush at the engine side.

The centre roller formed on the high-speed shaft is furnished with helical grooves in two directions which ensure efficient oil distribution. The outer race is also provided with oil grooves. The lubricating oil is cooled continuously by passing it through a cooler of simple design, and the circulation of the oil is maintained by a helical type pump which delivers it to the hollow centre of the low-speed shaft from which the bearings and rollers are fed. The main casing of the gear is water cooled, and special passages for the circulating water are provided.

The booster impeller space is isolated from the speed transmission gear by a series of three carbon ring packings of the ordinary turbine type, which are fitted to the shaft.

Throughout the trial the gear worked in a very satisfactory manner, and there was no undue heating in any part. The question of designing more powerful gears of this type is now under consideration, and further developments will be awaited with interest, particularly in the direction of the application of the gear to the problem of speed reduction for marine turbines.

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The contract has been let for the erection of a 2,500,000-dollar by-product coke-oven plant at Hamilton, Ontario. It will give employment to 250 men, and will be situated on a 35-acre site on the bay front.

## The Development of Naval High-Power Valves.*

For the purpose of this paper there is no need to enter into the details of our methods of design of transmitting valves, as this subject has already been dealt with by Stead and Gossling in papers read before this Institution.

The broad principles still in use are given briefly below. The requirements laid down usually take the form of a specified rating and a specified direct-current voltage which is available for the anode supply.

*Anode.*—The anode is rated by a number expressing the average power which it is capable of dissipating under normal working conditions. This dissipation takes place almost entirely by radiation. If the maximum temperature at which the anode can safely be run is known, the loss by radiation per square centimetre of the surface can be fixed. The watts that can be safely dissipated per square centimetre vary from 35 to 45, according to the material of the anode. Hence the requisite area of the anode is determined. The anode is conveniently made in cylindrical form, and the proportion of length to diameter of the cylinder can be varied within wide limits. Generally some mechanical consideration, such as the diameter of the valve cylindrical container, will be a factor in deciding this.

*Filament.*—An estimate is made of the effective mean anode voltage during the part of an oscillation when the anode current is flowing. Knowing the total energy to be given up to the anode per oscillation, one then arrives at a value for the emission, or electron current required from the filament. A safe working temperature is fixed upon, depending on the expected life of the filament. Usually a temperature between 2400 deg. and 2500 deg. (abs.) is taken. The known emissive properties of tungsten wire, either pure or thoriated, then enable the filament to be specified. There is a certain range of choice as to filament diameter, and it is usual to arrange that the final length of the filament element slightly exceeds that of the anode. This is desirable for reasons connected with the final heating-up of the anode by electronic bombardment in the last stage of evacuation of the valve.

*Grid.*—It remains, then, to fix the dimensions of the grid. Upon the proper choice of grid depends the whole working success of the valve. This is expressed by reference to the constant $m$ of the valve. The value of $m$ to be aimed at depends upon the circuit conditions under which the valve is to be used. Among the factors to be considered are the coupling arrangements of grid and anode circuits, the amplitude of the oscillations to be produced, and the ease with which the circuit can be set oscillating. The constant $m$ is a function of the anode and grid diameters, the grid spacing and the diameter of the wire from which the grid is made. Its numerical value in our valves may lie between 20 and 30, but it is possible to use a valve in which the value of $m$ is as high as 250. We have already fixed the anode diameter, and practical considerations lead us to fixing the grid diameter and diameter of grid wire; hence the grid spacing becomes determined and the valve is completely designed.

*Silica Valves.*—The silica used for the high-power valves developed at the Signal School, Portsmouth, is supplied by the Silica Syndicate, of Wallsend. Its outstanding features are its very high melting point and its low coefficient of thermal expansion. The latter property carries with it many advantages. There is practically no liability to cracking when the envelope is subjected to sudden local heating or cooling.

Many complicated constructions which would be impossible in glass can be carried out in silica. By means of

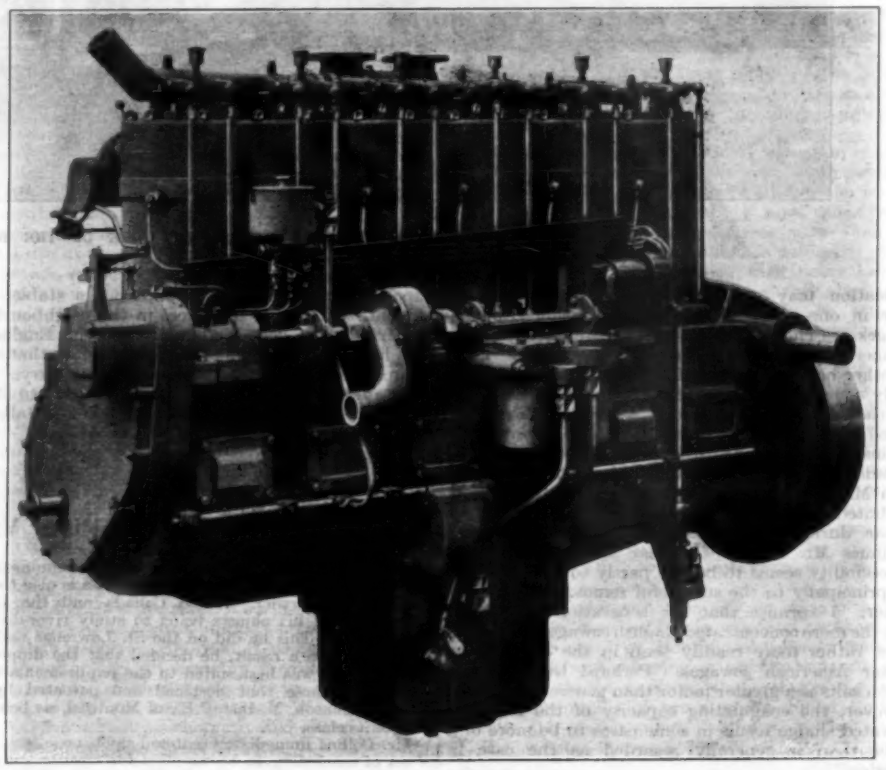
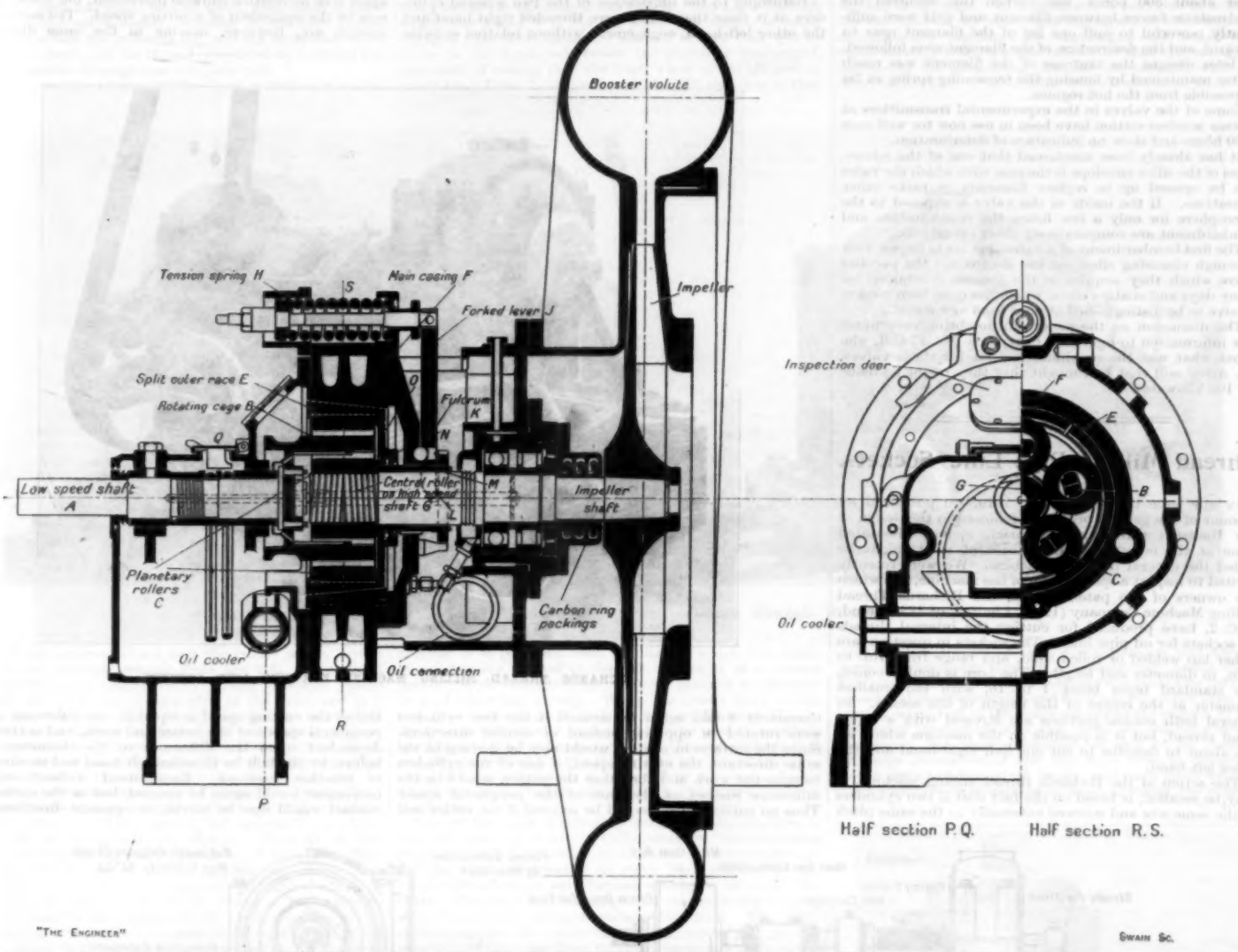


FIG. 2—ENGINE FOR DRIVING GAS BOOSTER

* Abstract of paper read before the Wireless Section of the Institution of Electrical Engineers by Mr. H. Morris-Airey.

# MATTEUCCI SPEED TRANSMISSION GEAR APPLIED TO A GAS BOOSTER

REAVELL AND CO., LIMITED, IPSWICH ENGINEERS




simple grinding tools a silica vessel can be opened up for replacements of filament, grid, &c., the operation being carried out with a certainty and reliability unknown in glass ware. The high melting point allows the silica vessel to be heated up to a much higher temperature than glass can withstand, and, if necessary, cooling by means of an air blast can be resorted to.

There are certain disadvantages in the use of silica. The first cost is somewhat high, but against this we have the long life of the envelope, which can be opened up for replacements almost indefinitely.

No simple method of sealing electrical leads directly through silica is known to us, but a seal provided by the Silica Syndicate has up to the present proved satisfactory for all requirements. It consists of a molybdenum wire sealed into a silica tube by means of lead. We have introduced a slight modification in the shape of the molybdenum conductor, and in this form the seals are perfectly satisfactory up to a current-carrying capacity of over 20 ampères.

The first proposal to use silica as an envelope was put forward almost as soon as it was realised that the valve had possibilities as a transmitter. The first silica valve was designed in 1916. Attempts were made to get the silica body constructed by manufacturers of silica mercury lamps, but without success, and it was not until after the success of the glass valves that the subject was again taken up seriously. The work was undertaken jointly by technical officers of the Signal School, Portsmouth, and the Air Force laboratory at the Imperial Institute. The principal Air Force officer concerned was Captain S. R. Mullard, who has since been closely associated with the manufacturng side of this work.

The result of our efforts was that at the beginning of 1919 a silica bulb of the requisite dimensions had been obtained and fitted with the appropriate anode, grid and filament for a rating of 2 kilowatts. The leads for anode, grid and filament were provided by means of the Silica Syndicate's lead seals; it remained, however, to exhaust and seal off this bulb.

At that time we were little aware of the difficulties ahead. Owing to the Armistice and the consequent demobilisation of Captain Mullard, the partnership between the Signal School and the Air Force laboratory came to an end. It was then decided to obtain the assistance of the Osram Robertson Lamp Works, where considerable experience in dealing with the pitfalls of exhaustion and bombardment had been gained through the manufacture of our glass valves.

After trials and experiments extending over several months the valve was sealed off and delivered to us in November, 1919. It just missed being successful, owing to the vacuum not being sufficiently good when the valve heated up. It should be pointed out that the conditions which this valve had been designed to fulfil were more exacting than in the case of glass valves. In order to radiate the heat produced at the rate of 2 kilowatts, the anode was intended to be run up to a bright red-heat, and the bombardment had, therefore, to be such that at this temperature no further gas was released from the metal or envelope.

There were, further, the sealing-off difficulties. The results of this first effort were, however, encouraging, and it was decided to make in the Signal School laboratories a serious study of the manufacturing difficulties of silica valves. The existing valve laboratory was extended, and a large room set aside for high-power valve construction. The wooden benches which had been in use for small valve work were discarded and metal frames substituted. This practically removed one of our most constant troubles, namely, the breaking down of the glass tubes used for connecting together the mercury-vapour pumps, gauges and valves. At a later stage all cemented joints between the vapour pumps and valves were eliminated, everything being constructed throughout of silica fused into one piece.

The equipment of the principal room included two double benches for high-power silica valves, and four benches equipped for smaller valve work. The latter could readily be converted for high-power work when the need arose. Silica bulbs of various sizes and shapes, and also the necessary metal anodes, grids, &c., were obtained, and various methods of freeing these from absorbed gas were tried.

We were already familiar with the principal methods employed by the manufacturers who had been associated with us in previous valve work. We also had valuable advice from Captain Mullard during this period. The result was that a good 2½-kilowatt valve was successfully sealed-off early in 1920. During the latter part of 1920 the construction details necessary for quantity production received considerable attention. These are mostly recorded in various Admiralty patents.

It was now possible to obtain from the Mullard Valve Company valves which were complete except as regards exhaustion. The bombardment and sealing-off still required much time and great care, but by September, 1921, the difficulties had been surmounted, and collaboration with the Mullard Company enabled this firm to deliver the valves exhausted and ready for use.

The first valves made for us were rectifying valves of about 4-kilowatt rating, and were followed almost immediately by a number of 2½-kilowatt transmitting valves.

The supply of valves for our immediate requirements being assured we next attempted a 10-kilowatt valve on the same lines, and towards the end of 1921 we were successful in exhausting and sealing-off a valve capable of dissipating 9½ kilowatts under working conditions.

The work of bombarding a large valve of this power was still an arduous task for the laboratory staff, as the process involved continuous attention for about thirty hours, and further efforts were made to reduce this time in order to make the operation reasonable from the manufaturing and costs point of view.

A careful study was made of the principal times of evolution of gas from both silica and metal, with the result that it was found possible to produce a 24-kilowatt valve with a bombardment period of less than one hour. To obtain this result, all silica and metal employed in the construction must be scrupulously clean and the greatest care taken that no oxidation of the metal parts occurs during the assembly of the valve.

After assembly, the process of baking and pumping out prepares the way for the final short bombardment. This preliminary treatment is of the greatest importance, and is essential if a perfectly clean valve is to be produced.

In the 24-kilowatt valve an emission current of about 3½ ampères was used; the filament wastage during bombardment was found to be almost negligible. In an actual case, the voltage required to produce the filament heating current of 20 ampères was 36.1 before bombardment, and 36.2 after bombardment.

During the preliminary stages of exhaustion a McLeod gauge of the usual design is employed to measure pressures down to 0.00001 mm. of mercury. Below this pressure the ammeter in the anode supply circuit affords a convenient indicator of the evolution of gas. If gas is being evolved, the ammeter reading does not remain steady but creeps slowly towards higher values, but when the bombardment is complete, and no further gas is being evolved, the ammeter needle remains absolutely steady.

At the commencement of the bombardment a curious effect is occasionally noticed. On switching on the full anode voltage, the grid being at a positive potential of about 300 volts, it sometimes happens that there is practically no emission current observable, or at all events there is a bare indication on the anode-current supply ammeter when the expected current is 3½ ampères. This effect may persist for as long as fifteen minutes, when it frequently happens that the emission suddenly sets in and thenceforth remains normal.

Another interesting phenomenon observed at the commencement of emission from the filaments of these large valves is the perceptible diminution of brightness of the filament when the anode voltage is applied. Owing to the conditions it is only possible to see the effect for a short time, as the anode quickly heats up and so masks the effect if it persists. It is possible that this dulling of the filament is accounted for by the "latent heat of evaporation" of the electrons. According to Richardson's theory the energy required by the emitted electrons in one of these large valves would be at the rate of about 15 watts. The filament is being supplied at the rate of about 720 watts; but it is conceivable that the emission taking place from a thin outer layer of the filament may momentarily lower

the surface temperature sufficiently to account for the observed effect.

The life of the silica valve is, in general, determined by the filament. In the earlier valves defects in mechanical design sometimes allowed the filament to become slack after about 500 hours' use. When this occurred the electrostatic forces between filament and grid were sufficiently powerful to pull one leg of the filament near to the grid, and the destruction of the filament soon followed. In later designs the tautness of the filament was much better maintained by housing the tensioning spring as far as possible from the hot regions.

Some of the valves in the experimental transmitters at Horsea wireless station have been in use now for well over 1000 hours and show no indication of deterioration.

It has already been mentioned that one of the advantages of the silica envelope is the ease with which the valve can be opened up to replace filaments or make other alterations. If the inside of the valve is exposed to the atmosphere for only a few hours the re-exhaustion and bombardment are comparatively short operations.

The first bombardment of a valve appears to have a very thorough cleansing effect on the electrodes; the peculiar lustre which they acquire in the process is retained for many days and enables metal which has once been used in a valve to be distinguished at once from new metal.

The discussion on the paper did not bring very much new information to light, but in reply to Mr. F. Gill, who asked what was the maximum output for these valves, Mr. Airey said that he thought that they might be made for 100 kilowatts.

## Thread Milling Pipe Line Sockets.

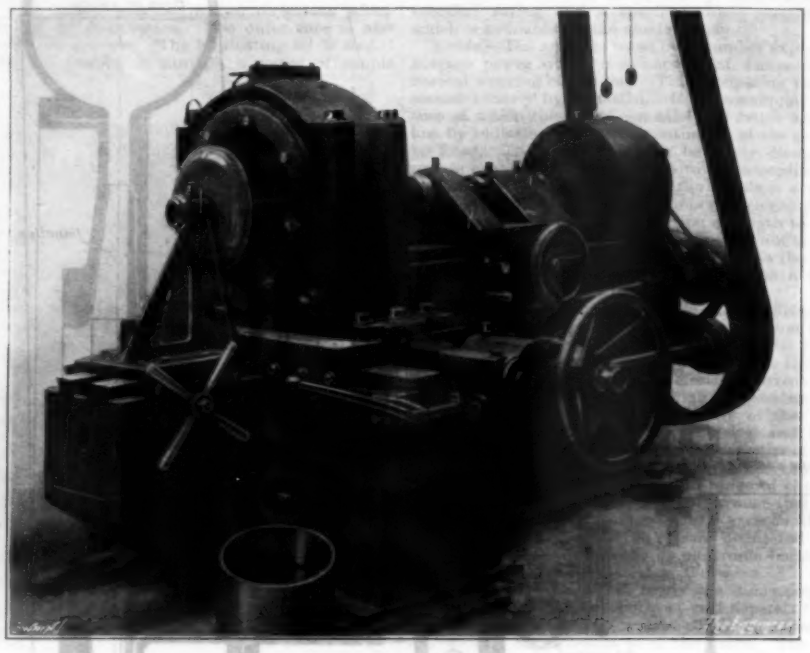
IN our issue of October 3rd, 1919, we published an account of the general principles followed in the design of the Richards thread milling machine, and illustrated some of the constructional features of what might be called the general purposes machine. We were recently invited to inspect a special form of the machine, one which the owners of the patent rights, the Richards Thread Milling Machine Company (1918), Limited, of 222, Strand, W.C. 2, have produced for cutting the internal threads on sockets for oil pipe lines. The sockets in question are either lap welded or rolled solid, and range from 7in. to 12in. in diameter and length. The bore is doubly coned, the standard taper being 1 in 16, with the smallest diameter at the centre of the length of the socket. In general both conical portions are screwed with a right-hand thread, but it is possible on the machine which we are about to describe to cut one half right-hand and the other left-hand.

The action of the Richards thread milling machine, it may be recalled, is based on the fact that if two cylinders of the same size and screwed externally to the same pitch are engaged and allowed to roll down an incline they will arrive at the foot of the slope without longitudinal displacement of the one relatively to the other. Provided the pitch is the same, the two cylinders need not be of equal diameter if they are mounted on axles and rotated at the same angular speed in the same direction. Let one of the cylinders be plain, and let the other be threaded and gashed longitudinally so as to form cutting teeth. Then, when the two cylinders are placed side by side, rotated at the same speed and fed towards each other, the plain cylinder, when the inward feed has been completed, will be threaded to the same pitch as the cutter, and that without any endwise movement of the cutter relatively to the work. Since the surfaces in contact are moving in opposite directions the cutting speed is the sum of the peripheral speeds of the work and cutter.

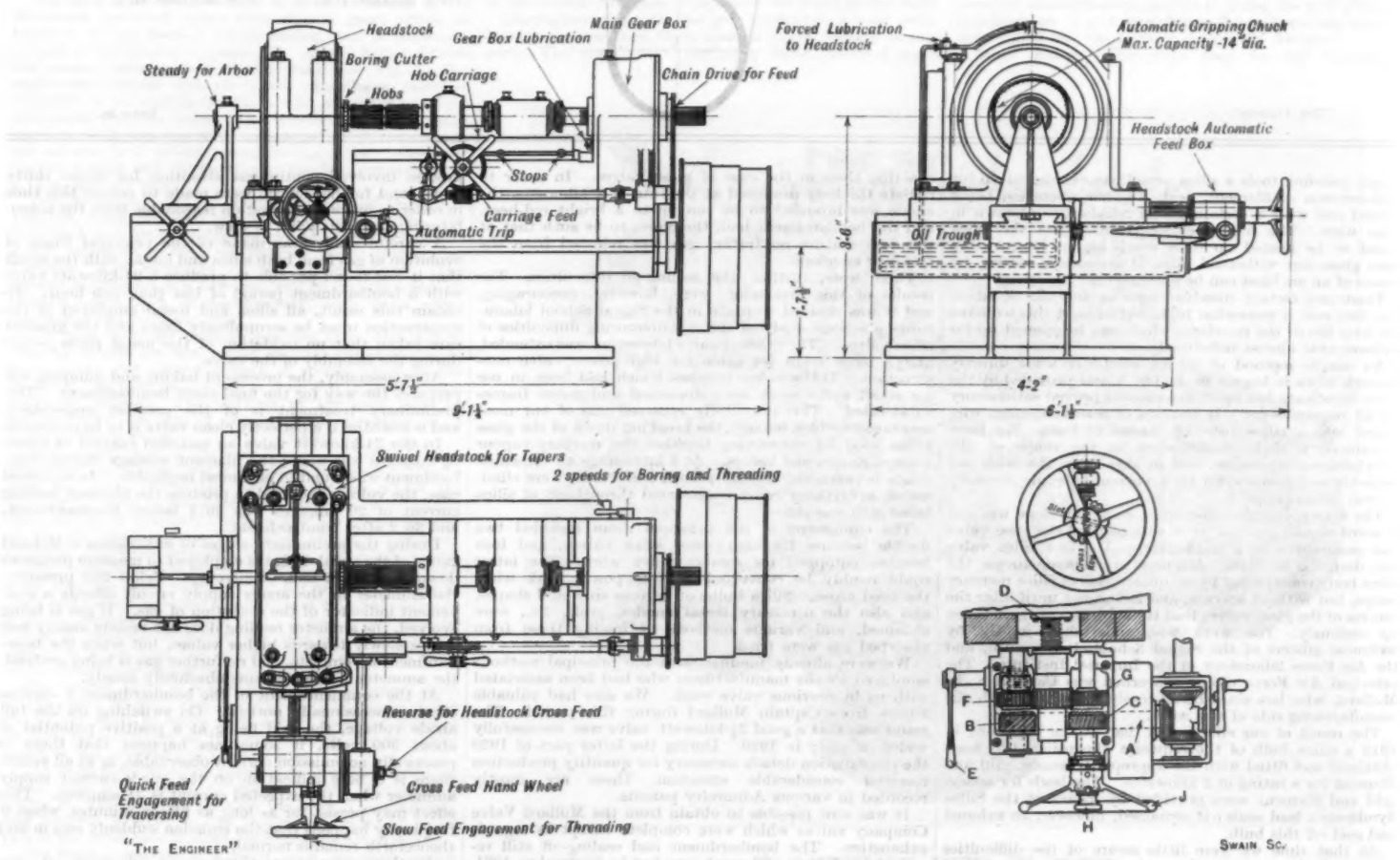
Returning to the illustration of the two screwed cylinders, it is clear that if one were threaded right-hand and the other left-hand, engagement without relative endwise movement would again be secured if the two cylinders were rotated in opposite instead of similar directions. Since the surfaces in contact would now be moving in the same direction, the cutting speed, if one of the cylinders became the work and the other the cutter, would be the difference instead of the sum of the peripheral speed. Thus no cutting speed would be secured if the cutter and work were made of the same diameter. Cutting, in fact, would only be possible by making the diameters considerably different. For external work, therefore, a right-hand threaded cutter is in general used for a right-hand screw, and the cutter and work are rotated at the same angular speed in the same direction. Important advantages and alternatives in this respect are made available by the use of a multiple threaded cutter, but into this aspect of the matter we need not here enter.

Now consider internal work. If an ordinary bolt and nut are rotated at the same speed there is no tendency for the nut to move up or down the bolt, nor is there any relative movement between the two. Let now the diameter of the nut be made two or three times that of the bolt without altering the pitch of either. Rotation at the same angular speed in the same direction would again give no relative endwise movement, but there would now be the equivalent of a cutting speed. The surfaces in contact are, however, moving in the same direction. Hence the cutting speed is equal to the difference of the peripheral speeds of the cutter and work, and is therefore dependent upon the difference in the diameters. As before, let the bolt be threaded left-hand and its direction of rotation reversed. Engagement without endwise movement would again be secured, but as the surfaces in contact would now be moving in opposite directions, the equivalent of the cutting speed would be the sum of the peripheral speeds. In general, it is not practicable on internal work to secure sufficient cutting speed combined with a reasonable size of cutter if the cutter and work are rotated in the same direction and are screwed to the same hand. Hence, for cutting a right-hand internal thread, it is preferable to employ a left-handed cutter with the cutter and work rotating in opposite directions.

The Richards machine, it will be gathered from these remarks, differs from the ordinary form of thread miller in three fundamental respects. First, the cutter teeth



RICHARDS THREAD MILLING MACHINE FOR PIPE LINE SOCKETS



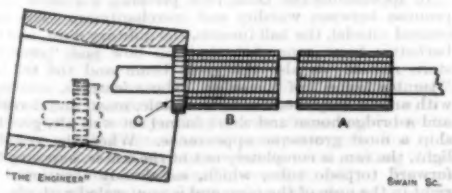

GENERAL ARRANGEMENT OF MACHINE AND DETAIL OF FEED GEAR

lie on a continuous helix, threadwise, and not on a series of parallel circular ridges. Secondly, instead of moving axially through one pitch distance while the thread is being milled, the cutter is not displaced relatively to the work. Thirdly, the thread is cut to the full depth only after the work has made several turns, feed being applied to the cutter continuously, whereas in ordinary thread milling practice the cutter is fed into the stationary work to the full depth and the thread completed by rotating the work thereafter through one complete turn.

In the machine illustrated the work is held in a special form of self-centring chuck and the cutter arbor, driven at one end through gearing from the belt pulley shaft and carried in a longitudinally sliding carriage, passes through the work and is supported at the outer end in a steadying bracket. The arbor carries two threading cutters and a narrow milling cutter of slightly greater diameter than the threading cutters, the object of which is to clean up and taper the socket bore before the threading is carried out. The head carrying the chuck can be swivelled so that the work may be set with its axis inclined to the axis of the cutter arbor at the angle desired for the tapered thread. The method of operation is indicated in the accompanying sketch. One-half of the socket is cleaned up and tapered by setting the plain milling cutter C to work against the rear wall of the bore. The arbor is then advanced longitudinally and the threading of this portion carried out by means of the cutter A. The work head is then displaced rearwards until the cutter C is bearing against the front wall of the second half of the bore. When this portion has been cleaned up and tapered it is threaded by means of the cutter B. The process lends itself to the attainment of accurately similar tapers, for once the chuck head has been set for the first taper it has not to be disturbed to secure the reverse taper on the second half.

It will be noticed from the general arrangement drawing that the gear-box provides two arbor speeds, one for boring and the other for threading. The arbor carriage is adjusted longitudinally from a handle near the centre of the bed, and to the shaft of this handle power feed may be applied by means of a dropping worm. This feed is, of course, required only when the sockets are being trued and tapered. It is automatically tripped by means of stops on the side of the arbor carriage. The movements required at the headstock consist of a drive to the chuck, a transverse adjustment of the head as a whole to suit varying diameters of work and to accommodate the cross shift of the work at the end of the first half of the machining operations and a slow power feed of the work on to the cutter until the full depth of thread has been secured.

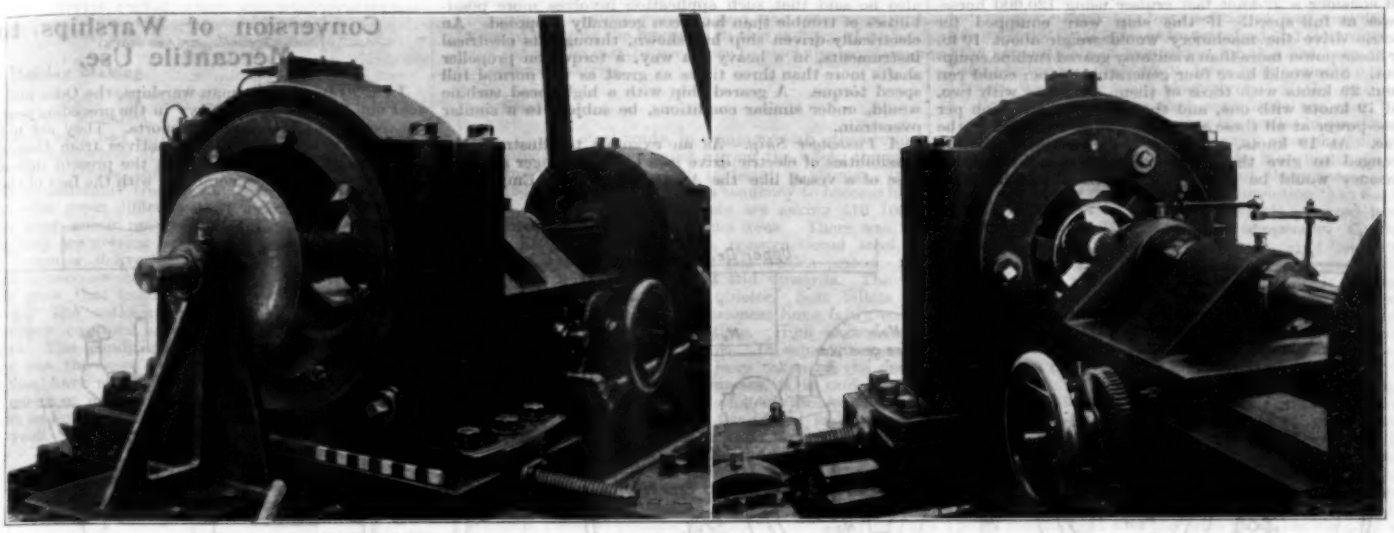
The details of the feed gearing are shown on an enlarged




METHOD OF CUTTING TAPERED THREAD

scale in the general arrangement drawing. Since the threading feed is first in one direction, and then for the second half of the socket in the opposite direction, reversing bevels are provided to communicate the motion to a longitudinal shaft A carrying a pair of worms. From either of the worm wheels B C power can be transmitted through a dog clutch and spur gearing to a nut on a screwed shaft D attached to the headstock. The gear wheel F is engaged with the worm wheel B by means of the lever E through the agency of a rack and pinion and communicates rapid traversing motion to the head when the cut has to be transferred from one side to the other of the socket. The worm wheel C is employed to communicate slow feed motion to the head when the thread is being milled. Normally, the wheels C and G are held out of engagement by a spring, but the clutch can be closed by pulling on the knob H and can be held closed until it is automatically released when a selected amount of feed has been attained. For the accomplishment of the latter object the knob on its rear face is provided with a key and the boss of the wheel J with a corresponding slot. When, therefore, the knob is pulled outwards and the wheel J is turned, the key rides on the plain face of the boss and will then hold the clutch closed until the rotation of the worm wheel C causes the knob to turn round to the extent required to allow the key to slip back into the slot in the boss and so bring about the opening of the clutch. The angle through which the wheel J is turned when the clutch is being engaged thus determines the amount of feed that will be given to the headstock before the clutch is disengaged, provided, of course, that the hand wheel is not allowed to move away from its original position. To secure it in that position it is provided with a collar in which two series of notches are formed to the left and right of a central notch. With these notches a spring plunger co-operates to hold the wheel steady. When the power drive to the feed gear is interrupted, and the key on the knob H is in the groove the wheel J, it is clear, can be used to transmit hand feed to the headstock by way of the worm wheels C B and the spur wheel F. For the present the rate of feed provided is constant, but it is intended to develop a design which will give a quick rate at starting and slow down at the finish.

One of the most interesting details of the machine is the self-centring chuck. Unfortunately, circumstances prevent our dealing with it at all fully. It must suffice to say that it is composed of six rings, each serrated on the inner circumference and formed with gear teeth on the outer. The rings are assembled and mounted side by side with their outer circumferences coincident. The inner circumferences are excentric to the outer and in the assembly of the rings these circumferences are made not to coincide. Thus, on rotating the rings by means of a pinion engaging with the gear teeth on the outer circumferences the rings are made to close down upon the work placed between them. For sockets of relatively small diameter three pads are attached to the rings so as to act as packing pieces, one such pad being fixed to the first and sixth rings, another to the second and fourth, and the third to the third and fifth. On the larger sizes of sockets the pads are not used, for they are found to distort the work into a trefoil section.



BACK AND FRONT VIEWS OF HEADSTOCK END OF RICHARDS THREAD MILLING MACHINE

## Australian Engineering Notes.

The Western Australian Government, six months ago, sent out a prospecting party to the country north-east of Laverton, and the finds were so encouraging that the State mining engineer was despatched to the scene to investigate. He has now reported that the find is promising, but does not warrant enthusiasm. The gold is spread over a wide area. The locations are Jutson's Rocks and Lang's Rocks, some 100 miles north-east of Laverton.

* * * * * *

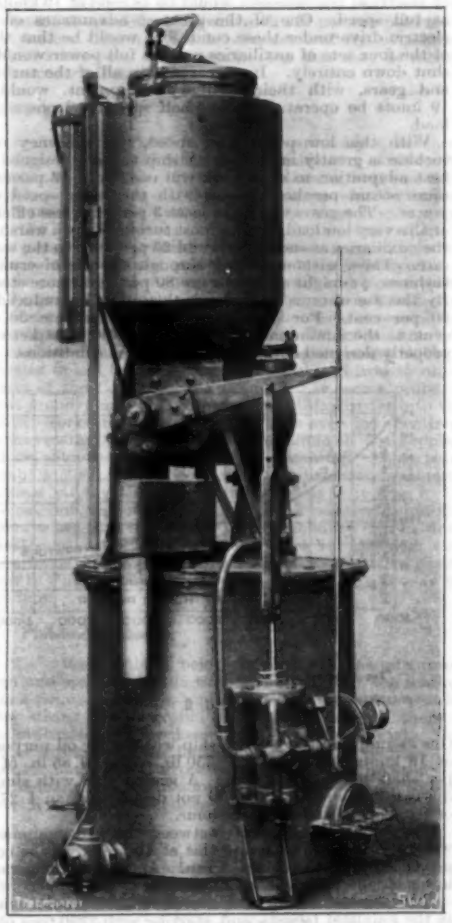
Promising discoveries have also been effected near the Trans-continental railway line. The leases, which are under option to the Mutooroo Company, are situated in sparsely timbered country at Mt. Juglah, 20 miles south-east of Bulong.

* * * * * *

The Bendigo Amalgamated Goldfields, which in 1917 undertook a large scheme comprising about 2500 acres and thirty-eight companies, but has since relinquished a considerable portion of the area, has surrendered a further 860 acres, which are now being made available to prospectors in leases.

## A Self-cleaning Acetylene Generator.

We recently inspected, both in course of manufacture and in actual service, a new type of acetylene gas generator which is being made by the Finnieston Engineering Company, Limited, of Scotstoun, Glasgow, and which, we understand, has been applied to shipyard work, scrap cutting and the manufacture of steel tubes with good results. The design was got out with the idea of producing a generator of simple and robust construction which, while possessing requisite flexibility, would continue to operate over long periods without attention. We reproduce herewith an illustration of the size designed for an output of 500 cubic feet of acetylene gas per hour. The vertical carbide container, which has a capacity for two and a-half hundredweights of carbide, is arranged directly over the gas generating chamber, and the carbide is delivered by a worm conveyor to a long delivery pipe which is carried below the level of water in the generating chamber. A reciprocating water engine, with an automatic throw-over valve, operates the conveyor by means of a lever and ratchet attachment. An adjustment is provided to control the ratchet feed by hand, and the speed of the engine is automatically regulated by controlling the water stop valve directly from the gas holder, so that the supply of carbide to the generating chamber corresponds with the demand for gas. The surplus water exhausted from the engine cylinder serves to cool the apparatus, and also to carry off the sludge through a hydraulically sealed overflow pipe. For all practical purposes the generator may be considered as self-cleaning, and no attention, other than the turning on and off of the water supply to the engine, or the refilling of the carbide container when the indicator shows the supply has been exhausted, is said to be needed. Although generators of this size have been in operation over a period of five to six weeks, and have dealt with as much as two tons of carbide without cleaning, the makers



SELF-CLEANING ACETYLENE GENERATOR

recommend that the interior spaces of the generating chamber should be examined and cleaned once a week. For this purpose a sludge cock and two inspection doors are provided.

In the latest installations the generator, purifier and gas holder are placed directly over two settling tanks made of reinforced concrete. An arrangement of weirs is fitted to each tank so that the overflow water is sufficiently cleaned to allow it to be discharged direct to a river or into a drain, while the duplicate tanks enable one to be cleaned out while the other is in use.

## Electric Ship Propulsion.

By W. L. R. EMMET.*

In this paper it is intended to show the possibilities of turbo-electric drive application in a type of ship in which it has never been used, namely, a large passenger ship, but before doing so it may be well to review some of its advantages in warships.

An example of the possible expediency of electric drive to a type of warship in which geared turbines have their best and simplest application may be interesting. We will consider a 32-knot fast cruiser using 120,000 horse-power at full speed. If this ship were equipped for electric drive the machinery would weigh about 10 lb. per horse-power more than a suitably geared turbine equipment. She would have four generating units; could run about 29 knots with three of them, 26 knots with two, and 19 knots with one, and the steam consumption per horse-power at all these speeds would be very nearly the same. At 19 knots, with one generator, with motors arranged to give the best turbine speed, the turbine efficiency would be actually better than at full speed, because the turbine would be less congested. With suitable arrangements and voltage adjustment the efficiency of electrical transmission would be as good at 19 knots as at full speed. One of the greatest advantages of the electric drive under these conditions would be that three of the four sets of auxiliaries used at full power would be shut down entirely. In a geared ship all of the turbines and gears, with their auxiliary equipment, would at 19 knots be operating at one-half speed and one-eighth load.

With this low power and speed, the efficiency of a turbine is greatly impaired. A ship turbine designed for best adaptation to such work will use about 52 per cent. more steam per horse-power with the lower speed and power. The gears will be at least 3 per cent. less efficient at this very low load, and, in most turbine-driven warships, the auxiliaries at such speeds add 25 per cent. to the water rate. Thus, without saving through the use of cruising turbines, we might expect to use 80 per cent. more steam. By the use of cruising turbines this might be reduced to 60 per cent. For comparison we will assume 50 per cent. as the minimum difference that could exist between properly designed equipment under these conditions. On this assumption the electric ship will use for oil purposes, at 19 knots with saturated 250 lb. steam, 0.85 lb. of oil per shaft horse-power hour. A geared ship with similar merit in turbine design could not do better than 1.27 lb. of oil per shaft horse-power hour.

The difference of weight between the two equipments will be about 535 tons, and this at 19 knots will be compensated for in 3600 miles of run. And the comparison at lower speeds would be about similar.

Such an electric ship could run at 19 knots from England to the Falkland Islands, and, starting with 2300 tons of oil fuel, would have 200 tons left on arrival. A similar geared ship, filled to equal displacement by carrying 2835 tons of oil, could not reach at this speed within 700 miles of the distance.

These figures, which are conservative, show that such qualities as are afforded by the electric drive may have great military value, even in a light, high-speed ship where the weight increase of machinery might at first sight be thought prohibitive.

*Gear Limitations.*—Since the turbine is much more efficient than the reciprocating engine, if we are to have steamers, we must have either geared turbine ships or electric drive. The possibilities of the geared turbine are well understood and need not be much discussed here. It may, however, be well to touch upon certain matters which have been quite generally overlooked in this connection. The writer can speak from some experience in this matter. The General Electric Company has, under his direction, been one of the largest producers of geared turbine ship machinery, having built about 350 ship equipments of this type aggregating over two million horse-power. From such experience it can be said that with suitable knowledge geared turbines can probably be applied with success to almost any type of vessel, it must also be said that such application involves more possibilities of trouble than has been generally supposed. An electrically-driven ship has shown, through its electrical instruments, in a heavy sea way, a torque on propeller shafts more than three times as great as the normal full speed torque. A geared ship with a high-speed turbine would, under similar conditions, be subject to a similar overstrain.

*A Passenger Ship.*—As an example to illustrate the possibilities of electric drive in a large passenger ship the case of a vessel like the Atlantic liner, the Empress of Canada, has been taken. The drawings—reproduced in Fig. 1—show a possible arrangement of electric drive machinery in such a ship. In these drawings the machinery is shown in an engine-room made as short as possible. Such an arrangement with generating units on a higher level is often very desirable, but various other arrangements could be used. Motors could be put in separate spaces nearer the propellers, which might effect some saving in shafts, &c.

Fig. 2 shows by curves the fuel rates for all purposes which should be given by such a ship when operating with two generators and with one. For purposes of comparison and verification of the claims here made a curve—Fig. 3—based on test figures from the fuel ship Kamoi of the Japanese Navy is also given. The Kamoi, a 9000 horse-power 15-knot ship was recently completed by the New York Shipbuilding Company with machinery built by the General Electric Company. The figures given were obtained by test during her first voyage. The differences between the performances of the Kamoi as shown, and of the larger ship—as indicated by Fig. 2—are fully accounted for by the difference in size of the generating units, and by more advantageous auxiliary and feed-heating arrangements. The results reported from the Kamoi are in good agreement with calculations based upon the factory test of her generating apparatus, and clearly indicate that the figures predicted for the larger ship are conservative. The steam conditions assumed are 245 lb. gauge pressure at the throttle valve, 150 deg. superheat and 28.5in. vacuum.

Most of the auxiliaries are driven from two condensing turbine direct-current generating units, with a third provided as a spare. Excess steam for heating the boiler feed from 85 deg. Fah. up to 220 deg. Fah. is extracted from the main units at 10 lb. gauge pressure. At all loads it was assumed that sufficient steam is taken direct from the boilers to evaporate 27 tons of fresh water per day. this requirement would need 200 lb. of oil per hour.

The installation includes two generating units, each having a capacity of 9500 kilowatts and weighing, without the condenser, 195,500 lb.; also two motors each of 12,250 shaft horse-power, weighing 236,000 lb. The combined weight of these parts, with the control equipment, is 911,400 lb., or 37.2 lb. per shaft horse-power. Some figures taken from the builders' trials, which were run at a speed of 15 knots, may be quoted. Approximate coal consumption—coal alone—for the first three hours 11,400 lb. per hour, average shaft horse-power, 9108. Approximate fuel consumption for the second three hours: oil fuel, 6792 lb. per hour, and coal, 1500 lb. per hour; average shaft horse-power, 9046. Steam condition as follows:—241 lb. gauge pressure at the throttle, 150 deg. superheat, 28.5in. vacuum. Through a mistake in opening valves five out of nineteen nozzles were unnecessarily operated in the throttled condition, which must have occasioned a loss of about 2 per cent.

* Institution of Naval Architects, March 22nd, abstract.

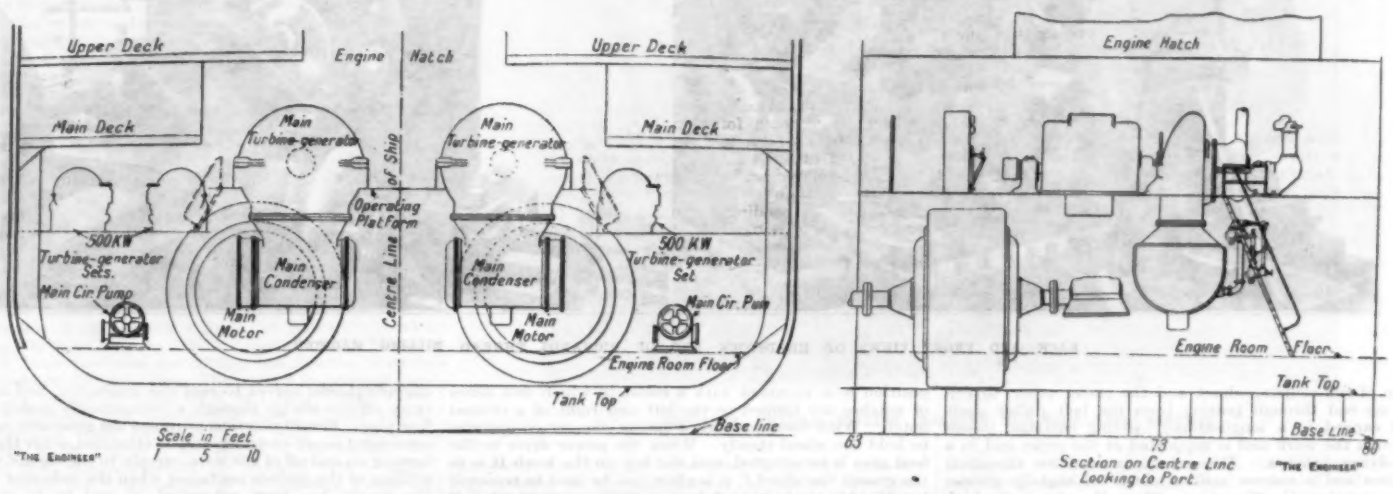



FIG. 1—PROPOSED ELECTRIC DRIVE FOR AN ATLANTIC LINER

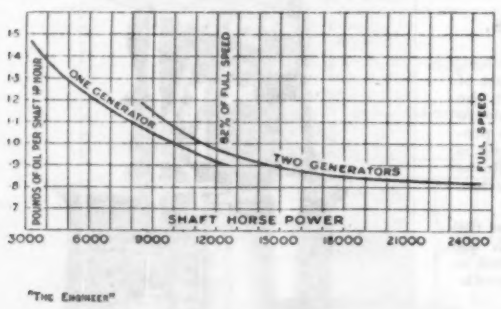



FIG. 2

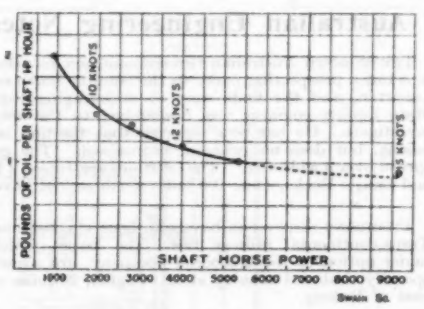



FIG. 3

## Conversion of Warships to Mercantile Use.

In 1920 two old German warships, the Odin and Ægir, sold out of the German Navy in the preceding year, were converted to locomotive transports. They are normally employed in transporting locomotives from Germany to Russian and Swedish ports, but the present demand for coal-carrying tonnage, combined with the fact of the ships being enforcedly idle till the reopening of the navigation in the Baltic, has induced the owners to send the Odin to Leith for coal, and provided an opportunity for observing the changes that have been wrought in the ship on conversion. The Odin and Ægir are the last completed of a class of eight coast-defence ships built for the German Navy between 1889 and 1894.

As designed they had a length of 253ft., beam 48ft. 9in., a draught of 17ft. 9in., and a displacement of 3600 tons. The armament consisted of three 9.4in. guns mounted *en barbette*, two forward and one aft, and a battery of 3.4in. quick-firers mounted on the upper deck amidships, five guns on each side. They had also two submerged and two above-water torpedo tubes—in the case of the Odin one of the submerged tubes was right in the nose of the ram.

The ships' vitals were protected by a partial belt of nickel armour. The belt was 8½in. thick, 125ft. long and 7½ft. wide—5ft. of it was below the waterline at load draught. The vessels had a 2in. protective deck and 8in. armour over the barbettes. The propelling machinery consisted of triple-expansion engines of 4300 horse-power, giving a speed of 15-16 knots. They had twin screws.

The forward barbette was of an oblong shape stretching right across the ship, and the two guns were situated wide apart with a partition between. They were mounted on the upper deck, which was cut short at the after end of the central superstructure, and the after 9.4in. gun was mounted on the remaining space of open main deck. The 3.4in. guns were carried, four in casemates at the corners of the citadel, and the remaining six in shields behind the bulwarks amidships. The Odin as designed had only one funnel, but was subsequently fitted with two. She had a military mast forward and a shorter pole mast aft.

In appearance the Odin now presents a curious compromise between warship and merchantman. The high central citadel, the tall funnels, the military mast, and the barbettes have gone, but the ram bow and "cruiser" stern remain, as also the great beam and the tell-tale "tumble home" of the sides. These features, combined with an ordinary mercantile forecastle, mast, and derricks, and a bridge-house and short funnel set well aft, give the ship a most grotesque appearance. When the vessel is light, the ram is completely out of the water, exposing the forward torpedo tube, which, as already mentioned, is right in the nose of the ram, and is now sealed with plating and covered with a false stem—the after tube is also visible in the stern.

Practically nothing but the shell of the original ship remains. The whole upper works have been removed down to the main deck, and the internal fittings have been gutted to form one large hold forward and a smaller one aft, between which are the bridge-house, cabins and engine-room. The forward hold has three hatchways served by one mast and twin derrick posts—the after hold has but one hatch served by twin derrick posts.

Looking forward from the bridge one is impressed with the extraordinary width of the deck and the stout rings attached to it for securing the locomotives. So great is this width that there is ample room to stow, between the hatches and the ship's side, the nine locomotives and tenders which the vessel is capable of transporting. There is no 'tween decks—the holds are clear from combings to floors.

Other changes include the stripping off of the armour belt, its area being now covered with ordinary plates laid vertically—about 2ft. wide and 5ft. deep—and the replacement of the steam engines originally fitted by two Augsburg M.A.N. engines of 550 horse-power each, giving

the ship a speed of 9 knots. Loaded with locomotives she draws about 13¼ft.; with a full cargo of 1950 tons of coal this is increased to 15ft.

It may be mentioned that the Odin and Ægir were converted at Wilhelmshafen Navy Yard, and that the Frithjof, an older ship of the same class, is at present being converted for the same purpose, and at the same yard.

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

**Holiday Making.**

There has been little business transacted this week in the Midlands, for many of the large iron and steel concerns have had extended holidays, proprietors having availed themselves of this opportunity to accumulate a little raw material, the scarcity of which has been causing them considerable trouble for some weeks past. It has been with great difficulty that industrial activities have been kept going up to now. Manufacturers complain that they are getting behind with engagements owing to the irregular deliveries of pig iron against contracts. Blast-furnace owners take refuge in the shortage of coke. It is plain that business is dislocated to an increasing extent. The outlook is so obscure that producers are extremely cautious about entering into fresh commitments. The conditions in the basic industries, which show not the least sign of improvement in regard to supplies, have naturally affected many branches of trade dependent on iron and steel for their products. Numerous works in South Staffordshire have been idle the whole of the week.

**Manufactured Iron.**

The rise in best iron prices was moderate enough to assist demand, and the Staffordshire manufactured iron-works are quite busy on good class material for shipbuilding and chain-making requirements. Values are firm at last week's figures, but buyers have little confidence in the maintenance of present values, and are keeping back their orders wherever possible. The only foreign material competing with local iron is No. 3 Belgian, still obtainable at £10 15s., delivered in the Black Country, but many consumers prefer local material of more reliable quality at £11 10s. Foreign deliveries are strictly on old contracts, the Belgian millmen being shy of new business. Iron-masters are feeling acutely the shortage of raw material and complain of the irregularity of deliveries. There is little chance of supplying deficiencies in deliveries from the open market, so that foundries and mills which have not stocks to fall back upon are in an awkward predicament. It is recognised that the situation will have to undergo a fundamental change before the raw material will be forth-coming for any considerable expansion in the finishing branches. Galvanised sheets have stabilised at £20 in the district, but demand has fallen off. Earlier bookings, however, have placed the makers in a comfortable position, and the mills are assured of work practically throughout the summer. The re-rolling mills continue busy, and the tube makers have a good deal of work in hand.

**Ironworkers' Wages Advanced.**

As a result of the ascertainment of selling prices under the Midland Iron and Steel Wages Board regulated by the sliding scale, puddlers and other forge and mill workers are to receive an advance of 2½ per cent. in their wages for the months of April and May. This wage advance has been brought about principally by the recent advances in the price of Staffordshire bars of merchant quality.

**A Veteran Staffordshire Ironmaster.**

On March 29th Mr. Michael J. Whitehouse, a veteran leader of the iron trade, was presented with a large silver salver by his colleagues in the South Staffordshire Ironmasters' Association, on the occasion of his retirement from the management of John Bagnall and Sons, Limited, after a connection extending over sixty years. Mr. Whitehouse has long been one of the most familiar and respected figures on the Birmingham Iron Exchange, and the heartiest good wishes are expressed towards him in his retirement.

**Pig Iron.**

The scarcity of pig iron, which is the most serious feature of the market at date, is unrelieved, and, with the coke position as unyielding as ever, furnace men are doing just as much business as circumstances will allow. One is still told of furnaces in several districts waiting to start when coke can be obtained more reasonably. The great shortage of coke is an insuperable obstacle to the starting of furnaces in this district, and it is impossible, therefore, to get adequate supplies of iron. Blast-furnace owners are behind in their deliveries and, as a rule, decline new business. It is almost impossible, in fact, to negotiate a new contract. Prices are firm and quotations regarded as nominal. The dearth of foundry material is restricting the operations of engineering shops, and firms having the necessary iron have to face the difficulty of insufficient coke. The relighting of four furnaces in Derbyshire, to which I referred in my last letter, and which has been made possible by the proprietors having some command of coke supplies, will not, I now learn, materially affect the supply of iron to the open market. The material is ear-marked for the company's pipe-casting department. This branch of foundry work is exceptionally busy just now, municipalities having had to place orders for the renewal of pipe lines which during the war got into a bad state.

**Coke Deficiency and the Foundries.**

Coke supplies continue extremely short, and many Midland foundries are reported to be working from hand to mouth, not knowing where the next day's supply will come from. Ironfounders are much concerned, and it is only by buying up whatever coke they can get, often at a high price, that they are able to keep their plant going. Pig iron is even more difficult to procure, some brands being practically off the market. The position is most unfortunate, as the difficulty has occurred at a time when the demand for castings, after a period of absolute stagnation owing to the state of the engineering industry, has commenced to revive. The position has undoubtedly arisen through the increased demand for coal, coke, and iron, on the Continent. Foundry owners are suggesting that the Board of Trade might well use its good offices to arrange a conference between the producers of coke and pig iron for foundry purposes and the consumers, with a view to securing the retention in this country of such coke and pig iron as may be necessary to meet the requirements of home industries.

**Steel.**

The steel trade, in common with other branches of industry, has been quiet during the week, though the demand for all classes of material is strong. In the finished branches prices have a tendency to become higher, and some Staffordshire makers are asking £10 10s. for joists, an advance of 5s. on the week. There was, however, no general revision in constructional steel, and material can be obtained at last week's prices. Small steel bars now command £12 and upwards. The billet market has become rather quieter. Soft billets have advanced to £9 15s., and consumers have fairly covered their requirements for the time. High carbon billets range from £10 10s. to £10 15s. In some quarters it is considered that the edge has been taken off the demand for semi-finished steel. Consumers, it is said, are now disposed to wait for a period of lower prices which they believe to be pending. The threatened lock-out in the building trade is expected to have an immediate effect upon constructional engineering and upon large under-takings calling for steel. There is scarcely any foreign material being brought into this district, and imports are restricted to old contracts. The new offers are not of a practical value as nothing is available until May or June. A feature of the local business, however, is the number of purchases made by German agents in Birmingham and the neighbourhood generally at prices well above those current in the district.

**Birmingham to Supply Underground Cars.**

The rolling stock works in the Birmingham area have a fair amount of work in hand for wagon building and railway requirements, but they could make a much larger production if called upon. They are pleased, therefore, to learn of the new orders which have been placed by the Underground Railway Company for the construction of 191 cars at a cost of £710,000. Local satisfaction is expressed that the manufacture of these will be spread over the following firms:—The Metropolitan Carriage Wagon and Finance Company, of Birmingham; the Birmingham Railway Carriage and Wagon Company, of Smethwick; and Cammell Laird and Co. It will be remembered that in August last five representative firms, three of them having works in Birmingham and the Black Country, were each asked to design and construct a sample car for the tube. The main points to be kept in view were lightness, comparative noiselessness, good lighting and ventilation and smooth running. The sample cars were delivered early in the year, and the best features of each have been combined in a standard design to which those firms that participate in the contracts will be required to conform. Delivery will be commenced in September of this year, and the new trains will be put into service on the new Moorgate and Hendon extensions of the Hamp-stead Tube when this section of the Underground opens to the public in the autumn.

**New Departure in Cannock Chase Coalfield.**

A splendid engineering feat has just been accom-plished in the Cannock Chase coalfield, where the Cannock Chase Colliery Company has constructed a drift by means of which the coal from two of its pits will be electrically drawn up an incline to the canal wharf instead of to the ordinary pit shaft by ponies, avoiding the transference at the pit head to locomotive traction to the wharf. Last week the finishing touch was put to the task which was entered upon over two years ago, and which is quite a new departure. The drift is the first of its kind to be con-structed in the Cannock Chase coalfields. It is 1250 yards long, and the total distance from the pit bottom at No. 3 pit to the wharf is about 1¼ miles. The average gradient of the drift is 2in. to the yard from the wharf and to the bottom; the topmost point to which the coal is hauled being 80 yards above the level of the pit bottom. A large new power-house made of concrete blocks has been erected at the wharf end, and in it is a 125 horse-power electric motor, auxiliary motors being also installed in the drift, which is illuminated throughout with electric light. As a result of the company's enterprise it will be possible to dispense with No. 2 shaft, and eventually with No. 3 shaft, for coal drawing purposes. It is estimated that about 1000 tons of coal per day will be conveyed through the drift forthwith, and this amount will be greatly augmented in due course. Eighty per cent. of the coal output will be machine gotten, and pit ponies will be entirely dispensed with.

### LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER, Thursday.

**General Conditions.**

The markets are slowly recovering their energy after the holiday, but the question as to whether the end of the advance in prices has come is not yet solved. There has been some recovery in the set-back in non-ferrous metals; but as there was no set-back in iron and steel, there is, of course, no occasion for recovery. In regard to that section the main matter of dispute is whether or not the recent rapid rise in prices is now tending to check trade. As to some sections of the iron market there can be no local dispute on this head, because it is patent that the selling of pig iron in Manchester has been checked, and indeed almost brought to a standstill, by some of the prices now asked, and the only point left for discussion is whether the check is permanent or merely temporary.

**Metals.**

On the closing day of the London copper market just before the holidays the disproportionate rise in best selected ingot copper was a feature which cannot be ignored. Your readers know that for a long time this class of refined copper has been selling at less than its value as reckoned by the prices for standard and electrolytic, and the general idea of the reason for this has been that the engineering and brass trades have been less active than the trades which use more electrolytic. If the recovery of "Best Select" means that consumers are now buying more freely, one may hope that the trades in question have taken a turn. It is a little too early after the holidays to see whether buying of copper in the Manchester district is yet more active than it was; but there seems to be a cheerful feeling even here, and a conviction that the back-ward movement in the market which occurred between March 23rd and 28th was merely temporary. Confidence in the future of the copper market would of itself make a vast difference, for it would mean that consumers all over the country would begin to replenish their stocks. It would be interesting and instructive to know whether this movement is now beginning. The stocks of consumers have been on the low side for a very long time. Probably next week we shall see some indications if it be true that consumers of copper for engineering purposes are buying more freely. From America come rather flamboyant predictions of a boom in trade which is said to be beginning there; but optimistic anticipations from America always suggest that there is something sinister behind them. Recently in the cotton trade these anticipations were very prominent a week before the big slump. The market in tin has not fluctuated quite so violently of late, and it seems possible that prices are settling down again. It has to be remembered that the price of tin has risen by about £50 per ton since the opening of the year, and is, even as I write, some £40 over the lowest prices last January. The cause of this advance has certainly not been found in European consumption, and is almost entirely the result of large American buying. If, as is now thought probable, American consumers are well supplied, the market may have to rely upon European consumption for a time. The statement that much of the Eastern stocks of tin had been sold to America during the last period of buying is now denied. The market for lead had only a small amount of weakness in sympathy with the temporary fall in copper. Some people attribute it to the threatened stoppage in the building trade; but one doubts whether, at present, building in this country has much effect on the lead market. The price is now steady, and one notices a very insistent demand for old lead, with £25 per ton paid for it by dealers. Spelter has been quiet and the consuming demand has been rather small; but that may be merely a temporary feature.

**Pig Iron.**

The markets for pig iron are very quiet here to-day, but this is because very few members came to the Exchange. There is certainly no weakening in the market, and it becomes a question of importance whether buyers of foundry iron are wise in delaying purchases for supplies for the second quarter of the year. Apparently there is less prospect than ever of an amicable settlement between France and Germany, and as long as this is delayed it is fairly certain that the drain on our coal and iron supplies will continue. To-day's cost of No. 3 pig iron in Manchester is about 116s. per ton delivered; but as the cost of the same quality of iron in the Cleveland district is 127s. 6d., it is clear that there is a danger of higher prices in Man-chester unless German supplies of fuel and iron to other parts of the Continent are resumed. It seems probable that foundry iron will go away from this district into the North Yorkshire district, and perhaps even into Scotland in increasing quantities, and thus diminish the supplies which would naturally come to Manchester. There is no doubt a strong prejudice amongst Manchester consumers against paying the present prices; but is it wise? Of course, one cannot undertake to speak positively, but the chances are that the present price of foundry iron in Man-chester is as low as it is likely to be for the next two months or so. We have this week of comparative quiet-ness to think about the matter, but afterwards it may be too late.

**Finished Material.**

Very little is being done here in manufactured iron and steel up to the time of writing, but the market has a firm appearance, and as semi-steel continues to be very strong and all costs of manufacture are up, there is no probability of weakening in finished material. The wages advance in the finished iron trade is perhaps not quite so much as was expected; but it may quite probably be made the occasion of another rise in iron prices, although this has not been announced yet.

**Scrap.**

The scrap market here, although scarcely opened after the holiday, appears to be stronger. There is not much buying of foundry scrap yet, but dealers are firmer, and many of them refuse to quote under 100s. per ton for broken machinery. Heavy wrought scrap is at 100s. to 102s. 6d. per ton delivered at the works.

**The Engineering Trades.**

There is little that is encouraging to report in connection with the various branches of the engineering industry of this district. After a brief holiday work was generally resumed on Tuesday last; but, in spite of the reports which I have been receiving from many quarters of the better tone and the increasing numbers of inquiries, the latter do not appear to materialise. The contributing factors to the unsatisfactory state of affairs are almost too

obvious to repeat. The most important, of course, is the lack of foreign customers. To this has to be added the almost hopeless condition of the cotton industry and the general unsettled conditions in other branches of industry, all of which tend to hinder the flow of orders for plant and machinery, which are badly wanted. Sir Eric Geddes' speech in Manchester a few days ago gives some ground for hope that before long there will be material reductions in the freight charges of the railways, which are generally considered to be still far too high and a handicap to British traders.

### Gas Power Plant for South Africa.

I had an opportunity a few days ago of inspecting an interesting plant which has been built in this country for the electric power station at Salisbury, Rhodesia. The plant consists of two four-cylinder vertical Browett-Lindley gas engines and generators of 400 horse-power each, supplied with gas from two Dowson-Mason suction gas plants. The engines have cylinders 24½in. diameter by 24in. stroke and run at 200 revolutions per minute. They have water-cooled exhaust valves, magneto ignition, and crank shaft governors. The gas plant is of the double-draught type, a portion of the air being drawn down through the fire, while the remainder is drawn upward from the bottom, the gas outlet being situated about the centre of the producer. In selecting this type of producer the purchasers had in mind the peculiarity of the native coal, which contains a high percentage of volatile matter. With the double-draught producer much of the volatile matter is consumed and trouble due to sticky valves is largely eliminated. The engines and gas plant have undergone an extended test at the engine makers' works at Patricroft with Rhodesian coal, of which 80 tons have been imported for the purpose. The coal is bituminous, has a fairly high calorific value, contains about 60 per cent. of carbon, over 20 per cent. of volatiles, and some 7 or 8 per cent. of ash. The tests have been very severe, the load being varied from practically nil to full load. The plant has given complete satisfaction and will shortly be shipped to South Africa.

Barrow-in-Furness, Thursday.

### Hematite.

There is very little alteration in the hematite pig iron trade. The holidays have perhaps reduced the bulk of inquiries, but makers hold as much as they want with the present number of furnaces in blast. They could sell much more if the supply of coke was not limited and the prospect of future trade secure. As soon as there comes a settlement in the Ruhr, and there are some who aver that it is nearer than the majority think, trade will become normal again and regular buyers will be relieved of worry. Prices are still showing a tendency to rise, and as long as the demand is greater than the supply this tendency will obtain. Glasgow is receiving much iron from this district, and the demand will improve as time goes on. There is a good market for the better qualities of iron used by engineers, and there is a chance that this business will improve when trade is more settled.

### Iron Ore.

The iron ore trade continues to be fairly well employed. There is more activity at the Cumberland mines than in the Furness district. A moderate amount is being sent out of the district. In the foreign ore trade shipments continue, but many cargoes are being dumped at the docks and put into stock instead of being delivered straight to the various works.

### Steel.

The steel trade is only fair. The Barrow rail mill is still engaged, and there is a good prospect for the hoop and small bar mills. The latter is turning out some fine bars, which are finding much favour with customers all over the country.

## SHEFFIELD.

*(From our own Correspondent.)*

### Germany's Loss is Sheffield's Gain.

The trade position in Sheffield, with special reference to the French occupation of the Ruhr, was effectively summed up by Mr. S. J. Robinson, the acting president of the Chamber of Commerce, at the annual meeting last week. "I am happy," he said, "to be able to congratulate the members upon a considerable revival in trade in the iron and steel industries, and we hope that it will soon extend itself to the crucible steel and lighter trades of Sheffield, including tools, cutlery, and plate. Whatever may be our individual opinions upon the rights and wrongs of the French occupation of the Ruhr, one thing is certain, that it has been a good thing for Sheffield. A great many of the orders which were going to Germany have been coming back to this country, and in many cases at increased prices. The impetus that it has given to the engineering and steel trade will, I think, stimulate demands from other quarters, and bring a more general prosperity, which will remain with us even if the Ruhr difficulty is immediately settled."

### A Short Holiday.

There is further evidence that the increase of steel prices has checked the placing of new business, and owing to this and the Easter holidays, few orders have been received this week. There are, however, still plenty of inquiries from overseas, and it will be impossible to meet half of them owing to insufficient output. The open-hearth furnaces continue extremely busy, and their products are sold for several weeks ahead. This heavy side of the city's industry could hardly afford to have an Easter Holiday. In the majority of cases, the works reverted to the old pre-war practice of continuing to run on Good Friday, and to close down for Easter Monday and Tuesday only. At least one works started up on Tuesday morning. The rolling mills of the country are crying out for further billets, while the billet makers complain that they cannot get full supplies of pig iron. The position in the latter respect has, however, somewhat improved during the past week or two, as rather more coke has been available, and there has consequently been an increased yield from the blast-furnaces. Preparations for increasing the supply of pig iron continue. The Sheepbridge Company has one idle furnace, but it is putting it in order for re-starting at the earliest possible moment. The Stanton Coal and Iron Company, Derbyshire, has decided to re-light four blast-furnaces which have been idle for upwards of two years. On the invitation of the directors, the furnaces will be lighted by Mr. J. R. Clynes, and his visit will be made the occasion of an interesting function, which will be attended by leading men in the industry.

### The Lighter Trades.

The hopes expressed by the acting president of the Chamber of Commerce with regard to a revival of the crucible steel and other lighter trades are shared by all in the city, but there is little evidence so far of their realisation. The department for cutting steels, which are made in the crucible and electric furnaces, is still in a very depressed condition. At the steel foundries there is some improvement on the lighter side, but heavy work is not on a satisfactory scale. The cutlery and plate industries continue to be only poorly employed, and the position does not differ from that which I have described in recent letters. There is still a great amount of unemployment in the city, although it is decreasing. The latest figures from the Employment Exchange show that the number of names on the registers is 29,709, a fall of 1115 as compared with the previous week. About a year ago the figure was 50,093, while as recently as February it was 34,306.

### Another Lost Tram Rail Order.

Perhaps it is not correct to describe the latest Hull order for tramway rails as "lost" to Sheffield, seeing that it does not appear to have ever had a chance of coming this way. But the fact remains that the corporation of the eastern port, wanting further supplies, has again gone to Belgium for them. It will be remembered that a few months ago it was in the market for a considerable quantity of material of this kind, and that it turned down the lowest British tender, which was from Sheffield, in favour of a lower one from Belgium. Now, in view of the increasing prices and the rush of work in the steel trade, it has decided to place another order at once, so as to avoid delay in carrying out its track renewals. It inquired of the Anglo-Belgian Improvements Corporation if it was prepared to supply further rails at the same prices as those of the present contract. This the firm was unable to do, but it quoted the following prices:—Rails, £11 1s. per ton; fish-plates, £12 10s.; sole plates, £13 2s. 6d.; representing an increase of £2 2s. 6d. per ton all round on its present contract. The tramways manager informed his committee that the increase which had taken place in steel prices represented £2 10s. per ton on this class of article, and the committee decided to purchase an additional 1000 tons of rails from the same firm. Needless to say, Sheffield is not pleased at this. The Lord Mayor, at the Chamber of Commerce meeting already referred to, described Hull's treatment of Sheffield as "rather shabby."

### More Colliery Developments.

Arrangements for developing the coalfields in South Yorkshire and neighbourhood proceed apace. An enterprise of that sort to be put in hand at once is the sinking of Firbeck Main Colliery, near Rotherham. A company was formed some years ago, but no progress has yet been made owing to the war, the increasing cost of sinking, machinery, &c. Now, however, it is intended to begin as soon as the contractors' line is made to the colliery. It is expected that the South Yorkshire Joint Lines Company, which has obtained a light railway order, will be able to proceed with the construction with very little delay. The Rossington Main Colliery, also near Rotherham, which has been in operation a few years, but has not yet anything like reached completion, is also being developed. The number of men now engaged is about 1400, as compared with 1000 last year, but many more are wanted. In the opinion of Lord Abereonway, chairman of the company, one or possibly two years will be needed to make the output really consistent with the money spent on the plant. The section of the coal is most satisfactory, being 6ft. 2in. thick, with a fair roof. Arrangements have been made for the linking up electrically of Rossington with Maltby and Dinnington. This will enable Rossington to dispense with the erection of new electrical units, and will ensure its getting electrical power economically delivered without further capital expenditure.

### Housing the Miners.

At Rossington, where eighty houses have been built and occupied recently, a further 300 are being put up by the Industrial Housing Association, which is also carrying out other extensive schemes in South Yorkshire and Derbyshire. Altogether, the Association has many thousands of houses under construction, at prices which Lord Abereonway describes as "astonishingly low." An important colliery village scheme is to be carried out by the Bolsover Company in connection with its new colliery at Clipstone, on the borders of Sherwood Forest. The site to be laid out for the village was occupied during the war by a large military encampment. There will be 600 houses, laid out on model lines, and built in blocks of two, three, and four, each house having a garden. The number of houses to the acre will be 8.70. There will be a village green of 9 acres, and the educational and social life of the inhabitants will be catered for by the erection of schools, places of worship, an institute, and a drill hall, and by the laying out of a large recreation ground containing enclosures for football, cricket, tennis, bowls, and running. When completed, Clipstone should rank among the finest colliery villages in the country.

### Cutlery Research.

Interesting particulars of the programme of the British Cutlery Research Association, which has its headquarters in Sheffield, were given at the annual meeting, held at the University last week. The Association now has eight or nine machines engaged in cutlery manufacture, and it is contended that the cost of production is lower than by the old processes. Steel freed from scale by a special process is used for table knives. The blade, bolster, and tang are made separately on the mass production process, and the three pieces are then joined by electric welding. For the manufacture of pocket knives, also, forging of any description is obviated. The work before the Association during the next twelve months includes an investigation into the composition and treatment of stainless steel for cutlery purposes; investigation into the best method of preparing the blank by welding three suitable pieces of material together, and the design of suitable machinery; and the construction of a suitable nichrome electric furnace for hardening table knives, pocket knives and scissors.

### A Metallurgists' Club.

The facilities for discussing technical problems in connection with Sheffield trades will be increased by the establishment of a club by the Sheffield Association of Metallurgists and Metallurgical Chemists. The Association has had a useful existence of several years, and has for some time desired to open a club. Now, suitable premises have been secured in West-street, and alterations and renovations are to be put in hand at once. It is intended that the club shall be a place where the city's metallurgists can meet, study, and discuss, under the most favourable circumstances, the science in which they are interested. The project is attracting considerable attention among the metallurgists, and should have the effect of strengthening the Association.

### New Shipbreaking Yard.

The big breaking-up yard at Inverkeithing, near the Rosyth docks, on the Firth of Forth, in course of construction for Thos. W. Ward, Limited, of Sheffield, is now nearing completion, and it is hoped to start operations there within a month. As soon as it is completed, a beginning will be made on the battleship Magnificent, and half a dozen other ships which the firm has waiting there.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

### Cleveland Mines Crisis Over.

The crisis which was gravely threatening the future of the ironstone mining industry in Cleveland has been overcome by the acceptance by the miners of the mineowners' proposal for an eight-hour working day. This decision has given considerable satisfaction in industrial circles on Tees-side, as it is confidently believed that it will pave the way for a brighter era for Cleveland miners, thousands of whom have been unemployed for nearly two years, and that it will also enable the owners to reopen the mines on a more stable and economic basis. It is expected that the owners will now make arrangements for the re-starting of many mines, and that within the next few months the industry will be fully employed. The change will involve an addition to the actual working day of about half an hour. The seven hours' day, which the miners have been working, included the time occupied in travelling from bank to the face. The eight hours' working day is from bank to bank. In return for the acceptance of the longer working day the owners offered increased wages to the lower-paid datal men, and this offer is expected to come automatically into operation. The owners have also promised to consider the question of new base rates and sliding scale, and these matters will become the subject of negotiations. In making the concession to the owners the Miners' Council points out that it claims the right to raise the question again at the expiration of twelve months. If the industry will bear it it hopes then to have restored to the men the privilege which they are now foregoing.

### Iron and Steel Exports.

Further evidence of the trade revival is reflected in the return of iron and steel exports from the Cleveland district during March, the total of 124,400 tons being the highest recorded for any month over the past two years. In February 66,242 tons were exported, and in January 80,607 tons. The pig iron shipments last month amounted to 67,618 tons, of which 50,197 tons went to foreign ports, as compared with 39,406 tons in February and 41,308 tons in January. Germany took 17,957 tons, America 11,205 tons, Italy 7510 tons, Belgium 4438 tons, and France 3030 tons. The exports of manufactured iron and steel reached 56,772 tons, as compared with 26,836 tons in February and 39,299 tons in January. India received 16,639 tons, Natal 3902 tons, Victoria 3785 tons, Burmah 3085 tons, and Japan 2183 tons.

### Cleveland Iron Trade.

There is little new of moment in the Cleveland pig iron trade. Every effort is being made to increase the output so as to overcome the pressing demand for iron at home and abroad, and preparations are being made to put several more blast-furnaces into operation in the near future when, it is hoped, better fuel supplies will be forthcoming. It is an almost hopeless task at the moment to secure prompt supplies of pig iron. Makers have all the orders they can cope with for weeks, and, in some cases, months to come. They have, in fact, difficulty in fulfilling contract obligations. It is expected, however, that the holiday period will effect some slight relief in the general situation. The steel works were idle from Saturday until Wednesday morning, and as the blast-furnaces have been kept in full operation there should be a little surplus iron for the market. Prices are firmly maintained, No. 1 being 132s. 6d.; No. 3 G.M.B., 127s. 6d.; No. 4 foundry, 125s.; and No. 4 forge, 120s.

**Hematite Pig Iron.**

Similar conditions prevail in the East Coast hematite pig iron trade. Makers are heavily sold forward, and whilst it might be possible to place a good order for, say, June delivery at 125s., the general market rates are 127s. 6d. per ton for mixed numbers, and 128s. 6d. for No. 1, whilst in some cases still higher figures are quoted.

**Iron-making Materials.**

Ore imports continue on a very heavy scale, and last month they were the highest recorded since May of last year. New business, however, is very quiet. Buyers have all they need, and are not disposed to enter into further contracts. Thus the price of best Rubio is quite nominal at 25s. per ton c.i.f. Tees. Coke is as scarce as ever. Deliveries under contract are heavily in arrears, and coke producers, whilst willing to renew old contracts with the ironmasters at 40s. per ton delivered at the works, refuse to book any new orders.

**Manufactured Iron and Steel.**

The position in the manufactured iron and steel trade is very encouraging. A huge volume of inquiries is pouring in, and makers have about as much work as they can cope with for the next two months. There is now little or no competition from the Continent, and the demand for semi-manufactured steel is considerably in excess of the supply. A further rise of 10s. per ton in the price of steel billets is announced, soft billets now being £10, medium £10 10s., and hard £10 15s.

**The Coal Trade.**

The Northern coal market is generally steady throughout, with all recent quotations firmly indicated over this month, and in some cases quite up to the end of June. There has, however, been little business transacted this week, the market being entirely under the influence of the holidays. Still there is a large and increasing inquiry from abroad, with Germany and most of the Scandinavian countries engaged in probing the market for probable supplies and also prospective values. Steam coals are still a very firm feature, and any kind of screened steams or smalls are quickly taken out at top prices. Gas coals are very steady for the prime and special sorts, but not quite so strong as before for commoner classes. Coking coals and bunkers are in good demand and firm. The coke position has generally weakened, with a drop of from 2s. 6d. to 5s. or more in price. Gas coke is easier, while for all classes of foundry there is a less insistent demand, and values are diminishing.

## SCOTLAND.

*(From our own Correspondent.)*

**Shipbuilding.**

DURING the month of March fourteen vessels of 38,005 tons aggregate were launched from Scottish shipyards. These figures show a decided improvement on the returns for January and February; but that is chiefly owing to the fact that one or two vessels of fairly large tonnage reached the launching stage about the same time. The returns for the quarter reach a total for the Clyde of twenty vessels of 68,204 tons aggregate, compared with thirty-one vessels of 106,062 tons in the first three months of 1922. The improvement in last month's figures cannot be reckoned to indicate an expansion in trade. Vessels are reaching completion, others are being laid down, and though a fair number of contracts have been placed, orders are not now coming forward so frequently as was the case a few months ago. The only contracts of any note placed during the month of March were three motor cargo ships for Messrs. Andrew Weir and Co., Glasgow, and one of 10,000 tons deadweight for the Nippon Yusen Kaisha, of Tokyo, to be built at Govan; a motor ship of 10,000 tons also for the last-named, to be built at Port-Glasgow, and a large cargo steamer at Greenock. Chief launches during March were as follows:—Patroclus, twin-screw geared turbine, 11,400 tons, for Messrs. Alfred Holt and Co., Liverpool; Coracero, cargo steamer, 7350 tons, for the Donaldson-South America Line, Glasgow; and the Dalgonia, twin-screw motor ship, 6100 tons, for the British India Steam Navigation Company, London.

**Continued Firmness in Pig Iron.**

Inquiries for pig iron are numerous, both for hematite and foundry qualities. The production is still limited, and makers have no difficulty in disposing of outputs at the higher prices quoted. Latest quotations were unchanged at £6 7s. 6d. for hematite, £6 5s. for No. 1 foundry, and £6 per ton for No. 3 foundry, all delivered Glasgow. The market tends to harden still further, however.

**Active Demand for Steel and Iron.**

The activity in the steel and iron markets is still very noticeable. Inquiries for materials of all descriptions are numerous, especially from overseas consumers. The majority of the works are now comparatively well placed and in a position to choose the most suitable specification. Quite a good amount of general business is being booked in spite of dearer prices. Orders from shipbuilders are not so prominent, but locomotive and constructional establishments and general engineers are absorbing large quantities of material. Steel sections are busy and the output is growing. Sheets, too, have a considerable turnover in home and export account, especially the latter, and mills are being taxed to their utmost. The greatest difficulty at present is the restricted supply of raw materials in the nature of sheet bars and slabs. Steel sections are firm at £10 per ton, and sheets maintain their position at £12 per ton for $^3/_{16}$in. and ¼in. sheets. Comparatively good reports come from the bar iron works. Local demands might be better, but the overseas business is fairly satisfactory. The re-rolled steel branch of this trade is an active one, bars, strips, &c., being in heavy demand, with further improvement apparent in foreign demands. Crown bars are still quoted on the basis of £12 per ton, with re-rolled steel bars round about £10 per ton.

**Quieter Coal Markets.**

With the scarcity of free coal has come a lull in buying. The collieries are very heavily booked, and practically nothing of any consequence is available for immediate disposal. Prices are maintained, but on occasion a buyer with a boat in position to take immediate delivery can gain some concession in price. Inquiries for forward delivery are still fairly prominent, but there is less disposition to pay the current rate of prices with deliveries so far off. A principal feature at present is the serious congestion at the docks, especially on the East Coast. A large number of steamers are awaiting cargoes, and the loading turn at the Firth of Forth ports is close on a fortnight. Aggregate shipments for the week amounted to 388,448 tons, against 374,214 tons in the preceding week and 260,955 tons in the same week last year. The returns for this year to date show an increase of 1,216,927 tons, compared with the same period in 1922. The home market for fuel is most uneven. Industrial demands are restricted partly by the prices charged, while household fuels are steadily bought, despite the maintenance of prices. Export quotations show almost no change, but an easier tendency is noticeable in some descriptions.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

**Coal Trade Position.**

SINCE I wrote a week ago the holidays have intervened, and consequently the conditions in the coal trade have not undergone much if any change. There was no work in the coalfield during the first two days of this week, though tipping operations at the docks were resumed on Tuesday. It is not unlikely that it will be difficult to maintain regularity of work at the docks on account of the shortage of coals this week. The docks are well supplied with ready tonnage; in fact, there are numerous steamers which were in dock before the vacation, but owing to the heavy loading pressure they were unable to get into berth. The majority of collieries are not quoting for the reason that they cannot tell exactly what outputs will be like and whether they will have any coals to spare. Their books are very full up for the whole of this month. Furthermore, coalowners are compelled to adopt a cautious attitude regarding additional commitments in view of the uncertainty prevailing in the coalfield on the non-unionist question.

**Miners and Strikes.**

The notices which the miners in the Rhondda No. 1 district were recently instructed to serve on the owners on the non-unionist question expired on Saturday last, and the delegates decided the same evening to carry them into operation. Assuming that sufficient men strike to prevent the collieries being worked, it means that there will be about 42,000 miners, together with nearly 5000 boys, idle. Since the notices were presented on March 19th the leaders have carried on a strenuous campaign against the non-unionists, and it is understood that a large number of men have fallen into line with the Federation, but that on Saturday last there were still as many as about 4000 to 5000 men outside. It is difficult to say whether the strike will be of long duration. When the notices were first served on the owners it was estimated that the number of miners who acted upon the instructions of their leaders was not more than 40 per cent., but this was subsequently challenged by the leaders. Safety-men who are not non-unionists are being allowed to continue to work. A week ago the executive of the Tredegar Valley miners recommended calling out the whole of the men on the non-unionist question, as it affected the members of the Mechanical Workers' Union; but when the recommendation was considered by the Tredegar Combine Lodge on Saturday evening the attitude of the executive was disapproved of, and on Monday a mass meeting of the miners passed a resolution in which the executive council was requested immediately to call a special conference to deal with the Mechanical Workers' Union on coalfield lines. It further advised the Markham and Nine Mile Point workmen to return to work and not continue to fight the mechanical workers on lines most favourable to that union.

**Proposed New Dock.**

Last week representatives of Cardiff shipowners, coalowners, coal-exporters, and other interests had an interview with the general manager of the Great Western Railway Company in London, on the question of the necessity for a new dock for Cardiff. Mr. J. C. Gould, M.P., who has taken a leading part in the agitation for extra accommodation, introduced the deputation, and each member stated his case. The general manager assured the deputation that the company would go fully into the matter of improved dock accommodation, and said that the company did not overlook the question of future developments at Cardiff. There will be another conference at an early date. It is reported that the company is not as yet satisfied that the available site at Cardiff is the best, and the deputation urged that wherever the accommodation is to be provided it should be west and not east of Cardiff. The Great Western Company has had several alternative plans submitted to it, and it is stated that the one that is favoured is not in Cardiff itself, but it is not looked upon with disfavour by the Cardiff shipowners and the other trading interests.

**Dock Charges.**

A meeting also took place last week in London between the general manager of the Great Western Railway Company and representatives of the General Committee of Commerce in South Wales in accordance with the agreement entered into with the former, which provided that the company shall meet the traders every three months for the purposes of considering the question of reductions in dock charges. The deputation strongly urged that a substantial reduction should be made on this occasion on the ground that the increase in tonnage warranted further concessions. The general manager stated that the company was prepared to reduce, as from April 1st, wharfage and cranage charges from 100 per cent. to 75 per cent., but in view of the commitments of the company in South Wales it was unable to give any further reductions at the present time. The charge for wharfage on coal is 4d. per ton, as against 2d. per ton before the war, so that the reduction granted is from 4d. to 3½d. per ton.

**Union Dispute Ended.**

Last week there was the possibility of a dispute between the Transport Workers' Federation and the National Union of General Workers resulting in a stoppage of work at the Cwmfelin Steel and Tin-plate Works at Swansea. Trouble arose over the secession of men from the former to the latter organisation. Notices which had been served were due to terminate on Saturday last, but as the result of conferences, the matter was settled. The men who were concerned in the dispute agreed to pay up their arrears to the National Transport Workers' Union, at the same time retaining their membership of the National Union of General Workers.

**Current Business.**

Operations on the coal market have been practically at a standstill during the past week, and it is unlikely that there will be any resumption until next week. The tone of the market is firm, and coals of all descriptions are scarce owing to the curtailed production caused by the holidays. The majority of collieries are behind in their commitments and have a good deal of tonnage awaiting supplies. For the time being prices are simply nominal, and for any small parcels that may be required and can be spared colliery salesmen can name their own prices. There seems every probability of the market keeping very firm throughout the remainder of this month though the demand from abroad is somewhat limited. It is reported that the Latvian State Railways have placed an order with Instone and Co., Limited, for 15,000 tons of coal, and that the same firm has secured a contract for 50,000 tons for the Lithuanian State Railways, a large proportion of these contracts being for Bedwas large coal.

# Latest News from the Provinces.

## WALES AND ADJOINING COUNTIES.

**Non-Unionist Strike.**

THE strike of miners in Rhondda No. 1 district commenced on Wednesday, but the probability is that before the end of the week the stoppage in this area will not be general. The chances are that some of the lodges will take individual action, and when their books are clear of non-unionists they will decide to return to work. In the case of the Tredegar Company's pits, work has been restarted. The Executive Council of the South Wales and Monmouthshire Mechanical and Surface Workers' Union, at a meeting at Cardiff on Tuesday, expressed its determination to fight the Miners' Federation for the continued existence of its union, and to inaugurate a campaign with this object.

## CATALOGUES.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria-street, S.W. 1.—A copy of the firm's stock list of motors and dynamos for December.

CLARKE'S CRANK AND FORGE COMPANY, Limited, Lincoln.—A copy of the "Buyers' Guide," containing pictures of forgings, crank shafts, also useful information.

JOHN TULLIS AND SON, Limited, St. Ann's Works, Glasgow.—An illustrated booklet on "Power and Its Transmission," giving particulars of the various types of belting manufactured by the firm, and their different applications.

## LAUNCHES AND TRIAL TRIPS.

INVERAVON, "N" type standard vessel; built by Harland and Wolff, Limited, to the order of the British Mexican Petroleum Company, Limited; dimensions, 428ft. by 53ft. 3in. by 38ft.; 6900 gross tonnage. Engines, triple-expansion; constructed by the builders; left port March 27th.

VEENDAM, twin-screw liner; built by Harland and Wolff, Limited, to the order of Holland-America Line; dimensions, 575ft. by 67ft. by 44ft. 9in.; to carry 300 first, 382 second, and 1222 third-class passengers. Engines, twin screws, pressure 215 lb.; constructed by the builders; trial trip, March 29th.

GLENCASSIE, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Canadian Lakes and Canals; dimensions, 252ft. by 42ft. 6in. by 20ft. 6in. Engines, inverted marine type with three cranks, pressure 180 lb.; constructed by Hawthorn, Leslie and Co., Limited; launch, March 29th.

## CONTRACTS.

THE LONDON UNDERGROUND RAILWAYS have just placed a contract with the Teesside Bridge and Engineering Works, Limited, for a bridge at Finchley-road, on the Edgware and Hampstead line. The work is to be completed within sixteen weeks.

THE POWER-GAS CORPORATION, Limited, has recently completed the construction and erection of a water gas plant for Synthetic Ammonia and Nitrates, Limited, of Billingham. The plant comprises three mechanical generators and auxiliaries with a rated capacity of six million cubic feet of gas per day.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W Coast— | |
| Native | 22/6 |
| (1) Spanish | 23/- |
| (1) N. African | 23/- |
| N.E. Coast— | |
| Native | — |
| Foreign (c.i.f.) | 25/- |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) Scotland— | | |
| Hematite | 6 7 6 | — |
| No. 1 Foundry | 6 5 0 | — |
| No. 3 Foundry | 6 0 0 | — |
| N.E. Coast— | | |
| Hematite Mixed Nos. | 6 7 6 | 6 7 6 |
| No. 1 | 6 8 6 | 6 8 6 |
| Cleveland— | | |
| No. 1 | 6 10 0 | 6 10 0 |
| Silicious Iron | 6 10 0 | 6 10 0 |
| No. 3 G.M.B. | 6 7 6 | 6 7 6 |
| No. 4 Foundry | 6 5 0 | 6 5 0 |
| No. 4 Forge | 6 0 0 | 6 0 0 |
| Mottled | — | — |
| White | — | — |
| Midlands— | | |
| (3) Staffs.— | | |
| All-mine (Cold Blast) | 13 0 0 | — |
| North Staffs. Forge * | — | — |
| " " Foundry | 5 12 6 to 5 15 0 | |
| (3) Northampton— | | |
| Foundry No. 3 * | — | — |
| " Forge * | — | — |
| (3) Derbyshire— | | |
| No. 3 Foundry | 5 7 6 to 5 10 0 | |
| Forge | 5 0 0 to 5 5 0 | |
| (3) Lincolnshire— | | |
| Basic (none offering) | 6 0 0 to 6 10 0 | |
| Foundry | 5 10 0 | — |
| Forge | 5 5 0 | — |
| (4) N.W. Coast— | | |
| N. Lancs. and Cum. | | |
| Hematite Mixed Nos. | 7 2 6 | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| Scotland— | | |
| Crown Bars | 12 0 0 | — |
| Best " | — | — |
| N.E. Coast— | | |
| Crown Bars | 12 0 0 | — |
| Tees | 10 0 0 | — |
| Lancs.— | | |
| Crown Bars | 12 10 0 | — |
| Second Quality Bars | 11 15 0 | — |
| Hoops | 15 0 0 | 14 15 0 |
| S. Yorks.— | | |
| Crown Bars | 12 10 0 | — |
| Best " | 13 10 0 | — |
| Hoops | 15 10 0 | — |
| Midlands— | | |
| Crown Bars | 12 10 0 | — |
| Marked Bars (Staffs.) | 14 0 0 | — |
| Nut and Bolt Bars | 11 10 0 to 11 15 0 | |
| Gas Tube Strip | 12 10 0 | — |

## STEEL.

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) Scotland— | | |
| Boiler Plates | 13 0 0 | — |
| Ship Plates ¾in. and up | 9 15 0 | - |
| Sections | 9 5 0 | — |
| Steel Sheets ⅛in. to ½in. | 12 0 0 | — |
| Sheets (Gal. Cor. 24 B.G.) | — | 19 10 0 |

## STEEL (*continued*)

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. Coast— | | |
| Ship Plates | 10 10 0 | — |
| Angles | 10 0 0 | — |
| Boiler Plates | 14 0 0 | — |
| Joists | 10 0 0 | — |
| Heavy Rails | 10 10 0 | — |
| Fish-plates | 14 10 0 | — |
| Channels | 9 5 0 | — |
| Hard Billets | 10 15 0 | — |
| Soft Billets | 10 10 0 | — |
| N.W. Coast— | | |
| Barrow— | | |
| Heavy Rails | 10 5 0 | — |
| Light " | 13 0 0 | — |
| Billets | 11 0 0 | — |
| Manchester— | | |
| Bars (Round) | 12 0 0 | — |
| " (others) | 11 0 0 to 11 5 0 | |
| Hoops (Best) | 15 5 0 | 15 0 0 |
| " (Soft Steel) | 13 15 0 | 13 10 0 |
| Plates | 11 0 0 to 11 10 0 | |
| " (Lancs. Boiler) | 13 10 0 | — |
| Sheffield— | | |
| Siemens Acid Billets | 13 0 0 | — |
| Bessemer Billets | 13 10 0 | — |
| Hard Basic | 10 15 0 | — |
| Intermediate Basic | 10 10 0 | — |
| Soft Basic | 10 0 0 | — |
| Hoops | 12 15 0 to 13 5 0 | |
| Soft Wire Rods | 13 0 0 to 13 10 0 | |
| Midlands— | | |
| Small Rolled Bars | 12 0 0 | — |
| Billets and Sheet-bars | 9 10 0 to 9 15 0 | |
| Gas Tube Strip | 12 0 0 | — |
| Sheets (20 W.G.) | 11 10 0 to 12 0 0 | |
| Galv. Sheets (f.o.b. L'pool) | 19 10 0 to 20 0 0 | |
| Angles | 10 5 0 | — |
| Joists | 10 5 0 | — |
| Tees | 11 5 0 | — |
| Bridge and Tank Plates | 10 10 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| Swansea— | |
| Tin-plates, I.C., 20 by 14 | 25/- to 25/6 |
| Block Tin (cash) | 219 0 0 |
| " (three months) | 219 15 0 |
| Copper (cash) | 75 10 0 |
| " (three months) | 76 5 0 |
| Spanish Lead (cash) | 28 5 0 |
| " (three months) | 28 5 0 |
| Spelter (cash) | 36 2 6 |
| " (three months) | 32 2 6 |
| Manchester— | |
| Copper, Best Selected Ingots | 80 0 0 |
| " Electrolytic | 83 10 0 |
| " Strong Sheets | 106 0 0 |
| " Loco Tubes | 0 1 2½ |
| Brass Loco Tubes | 0 1 1 |
| " Condenser | 0 1 2½ |
| Lead, English | 30 0 0 |
| " Foreign | 29 0 0 |

## FERRO ALLOYS.

*(All prices now nominal.)*

| | Per Ton. | Per Unit |
|---|---|---|
| Tungsten Metal Powder | 1/11 per lb. | |
| Ferro Tungsten | 1/5 per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £23 | 10/6 |
| " 6 p.c. to 8 p.c. " | £21 0 0 | 8/- |
| " 8 p.c. to 10 p.c. " | £20 0 0 | 8/- |
| " Specially Refined | | |
| " Max. 2 p.c. carbon | £52 0 0 | 20/- |
| " " 1 p.c. " | £62 0 0 | 22/6 |
| " " 0·75 p.c. carbon | £72 0 0 | 25/- |
| " carbon free | 1/6 per lb. | |
| Metallic Chromium | 4/6 per lb. | |
| Ferro Manganese (per ton) | £16 for home. | |
| " Silicon, 45 p.c. to 50 p.c. | £12 10 0 scale unit | 5/- per |
| " " 75 p.c. | £20 0 0 scale unit | 6/- per |
| " Vanadium | 17/- per lb. | |
| " Molybdenum | 9/6 per lb. | |
| " Titanium (carbon free) | 1/1 per lb. | |
| Nickel (per ton) | £130 | |
| Cobalt | 12/- per lb. | |
| Aluminium (per ton) | £82 to £100 (British Official.) | |

## FUELS.

### SCOTLAND.

| | Export. |
|---|---|
| Lanarkshire— | |
| (f.o.b. Glasgow)—Steam | 27/- |
| " " Ell | 29/- |
| " " Splint | 31/- to 35/- |
| " " Trebles | 31/- |
| " " Doubles | 31/- |
| " " Singles | 30/- |
| Ayrshire— | |
| (f.o.b. Ports)—Steam | 27/- |
| " " Splint | 31/- |
| " " Trebles | 31/- |
| Fifeshire— | |
| (f.o.b. Methil or Burntisland)—Steam | 29/6 to 33/6 |
| Screened Navigation | 36/- |
| Trebles | 31/6 |
| Doubles | 31/- |
| Singles | 30/- |
| Lothians— | |
| (f.o.b. Leith)—Best Steam | 31/6 |
| Secondary Steam | 28/6 |
| Trebles | 31/6 |
| Doubles | 31/- |
| Singles | 30/6 |

### ENGLAND.

| | |
|---|---|
| (8) N.W. Coast— | |
| Steams | 30/6 |
| Household | 46/8 to 57/6 |
| Coke | 42/6 |
| Northumberland— | |
| Best Steams | 33/6 to 35/- |
| Second Steams | 30/- to 32/- |
| Steam Smalls | 22/- to 25/- |
| Unscreened | 20/8 |
| Household | 25/- to 28/- |
| Durham— | |
| Best Gas | 33/- to 35/- |
| Second | 32/6 |
| Household | 25/- to 28/- |
| Foundry Coke | 75/- to 77/6 |
| Sheffield— Inland. | |
| Best Hand-picked Branch | 32/6 to 34/6 — |
| Barnsley Best Silkstone | 28/- to 30/- — |
| Derbyshire Best Brights | 25/6 to 27/6 — |
| " " House | 23/- to 24/6 — |
| " " Large Nuts | 20/6 to 22/6 — |
| " " Small " | 17/- to 19/- — |
| Yorkshire Hards | 22/- to 24/- — |
| Derbyshire " | 21/- to 24/- — |
| Rough Slacks | 11/- to 12/6 — |
| Nutty " | 10/- to 12/- — |
| Smalls | 6/- to 8/- — |
| Blast Furnace Coke (Inland) | 24/- to 27/- |
| " " " (Export) | 44/- to 47/- |

### (9) SOUTH WALES.

| | |
|---|---|
| Cardiff— | |
| Steam Coals: | |
| Best Smokeless Large | 37/6 to 40/- |
| Second " " | 35/- to 37/6 |
| Best Dry Large | 34/- to 36/- |
| Ordinary Dry Large | 32/6 to 33/6 |
| Best Black Vein Large | 35/- to 37/6 |
| Western Valley " | 34/- to 35/- |
| Best Eastern Valley Large | 34/- to 35/- |
| Ordinary " " | 31/- to 33/- |
| Best Steam Smalls | 27/6 to 30/- |
| Ordinary " | 25/- to 27/6 |
| Washed Nuts | 30/- to 32/6 |
| No. 3 Rhondda Large | 33/- to 35/- |
| " " Smalls | 28/- to 30/- |
| No. 2 " Large | 30/- to 32/- |
| " " Through | 27/6 to 28/6 |
| " " Smalls | 23/- to 25/- |
| Coke (export) | 70/- to 80/- |
| Patent Fuel | 40/- to 47/6 |
| Pitwood (ex ship) | 26/- to 27/- |
| Swansea— | |
| Anthracite Coals: | |
| Best Big Vein Large | 40/- to 45/- |
| Seconds | 35/- to 40/- |
| Red Vein | 30/- to 32/6 |
| Machine-made Cobbles | 45/- to 50/- |
| Nuts | 45/- to 50/- |
| Beans | 45/- to 47/6 |
| Peas | 20/- to 23/- |
| Breaker Duff | 12/- to 13/- |
| Rubbly Culm | 15/6 to 16/- |
| Steam Coals: | |
| Large | 28/- to 30/- |
| Seconds | 26/- to 27/- |
| Smalls | 17/- to 20/- |
| Cargo Through | 23/- to 25/- |

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b

* Quotations extremely high and nominal.

# French Engineering Notes.

*(From our Correspondent in Paris.)*

### Fiscal Tariffs.

THE system of coefficients which has been in operation during the past five years has proved fairly satisfactory as a means of compensating for the fluctuations in money values and of adjusting import duties in a way to protect new industries. The law authorising the Government to impose coefficients having expired at the end of last year a new permanent tariff was prepared; but, owing to the existing complicated state of things, the Minister of Commerce has found it necessary to send a circular letter to all the industrial and other groups asking them to suggest modifications that they may consider desirable in their particular interests. According to that letter the idea of the Government is to preserve the present method of establishing the duties on the weight basis, but they will be adjusted in such a way as to correspond as nearly as possible to the value of the goods. It is not proposed to adopt an *ad valorem* scale of duties, except in certain cases, as they leave the way open to an arbitrary appreciation that often gives rise to disputes. It will therefore be necessary to fix upon a more complete nomenclature of goods, and the industrial groups are asked to subdivide the names of goods as much as possible so that the duty imposed on weight will correspond to the value. The Minister points out that in fixing the tariffs the Government has to take into account the general interests of consumers, for higher import duties mean higher selling prices, and any extra burden on the consumer is only justified on condition that the producers do their best to meet foreign competition by bringing down manufacturing costs. The tariffs should therefore be based upon the difference between the production costs at home and the cost of similar goods manufactured abroad under normal conditions. At the same time, as the new tariff is to be permanent, there can be no variations in the methods of imposing the duties, and it is proposed therefore to assess them in gold francs, the idea, further, being that the development of a foreign trade in this way will be favourable to the re-establishment of a gold standard. The new law will also provide for the protection of "key industries," and dumping will be checked by special duties equal to the amount of direct or indirect premiums paid in foreign countries on account of goods for export.

### Colonial Railways.

The official opening this week of the railway between Rabat and Fez and of the new wharves at Casablanca marks the first important stage in the extensive programme of public works being carried out in the African Colonies. The normal gauge railway between Rabat and Fez is a continuation of the existing line from Fez to Tangier, and is now being extended from Rabat to Casablanca, making a total length of about 1100 kiloms. On the section now being opened the first half from Rabat passes over level country, where it was only necessary to build two bridges and a viaduct, but between Petitjean and Fez the railway is a succession of tunnels, viaducts and embankments, and most of this work was carried out during the war under conditions of great difficulty. The importance of the railway lies in the fact that it will enormously facilitate the phosphate traffic through Casablanca and will help considerably to open up Morocco to agricultural development. The harbour works at Casablanca are well advanced, and the official party which has gone to Rabat for the opening of the railway will also inaugurate the new landing stage at Casablanca, built against the principal breakwater, having a length of 1900 m. A transversal breakwater is now under construction to within 500 m. of the principal structure. In the other Colonies also, the programme of railway construction is being actively carried out. In Madagascar 415 kiloms. of line have just been completed at a cost of 55 million francs, and in West Africa the extension of the line from Kayes to Bamako will be put into service in September next, bringing up the total of new railways in that Colony to 2000 kiloms. The Government of West Africa has been authorised to raise a loan for the execution of the various works necessary for the development of the Colony. In all cases the provision of transport facilities has had the effect of increasing trade, which is improving in a way that seems to justify the belief in the future of the African Colonies as a source of supply of foodstuffs and raw material for the mother country.

### A National Fuel Week.

Experiments and research work continue to be carried out with a view of employing locally produced fuels for power purposes, and the results already obtained are particularly encouraging, especially as regards the number of tractors and lorries which are at present equipped with suction gas plants using charcoal or wood. Next month some further interesting trials are to be held at Toulouse, where the Automobile Club, under the patronage of the Minister of Public Works, will organise a "national fuel week." The vehicles competing will be divided into the following categories:—(*a*) Petrol motors adapted to run on a fuel containing a percentage of alcohol; (*b*) vehicles using heavy oils or vegetable oils from the Colonies; (*c*) electric vehicles with storage batteries; (*d*) vehicles with suction gas plants using wood or charcoal; and (*e*) steam vehicles in which steam is raised by fuels other than coal or coke. The trials will begin on May 13th and will consist of daily runs around Toulouse. Valuable work is being done at the Faculty of Sciences at Toulouse by Professor Sabathier and Professor Mailhe, who have obtained extremely interesting results with the synthetic production of petrol and oils, and so important is this field of research that an Institute of Carburants has been created at the Faculty of Sciences of Montpellier. It will be remarked that electric vehicles are included in the categories of lorries competing at Toulouse. Several French makers are now building electric lorries in the belief that they will offer special advantages with the carrying out of the rural electrification scheme.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

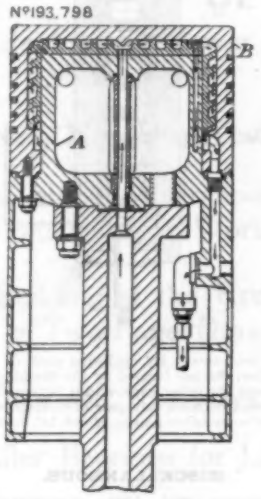
*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## INTERNAL COMBUSTION ENGINES.

193,798. August 19th, 1921.—COOLING PISTONS, The General Electric Company, Limited, Magnet House, Kingsway, London, W.C. 2, and B. F. Pochobradsky, 19, Cadogan-court, Draycott-avenue, London, S.W. 3.

This piston is made in two parts, the main body A and a cap B. The cap, which is subjected to the high temperature of the explosions, is made as nearly as possible of uniform thickness.

N°193,798



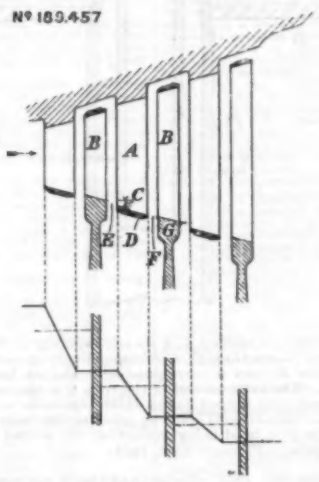

The cooling water is circulated between the cap and body, and is led through a spiral passage, as shown by the arrows. The ribs forming the spiral support the piston cap against the explosion pressure and the cap can consequently be made comparatively thin.—*February 19th*, 1923.

## TURBINE MACHINERY.

189,457. November 21st, 1922.—IMPULSE TURBINES, Aktiengesellschaft Brown Boveri et Cie., Baden, Switzerland.

This form of blading is said to obviate the necessity for the partitions usually placed between the wheels of impulse steam turbines. The fixed blading A is of greater radial length than the moving blades B, by an amount C. The result is that the

N° 189,457



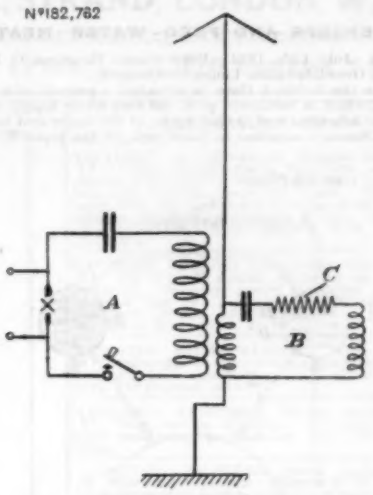

jet of steam issuing from the moving blades A jumps the intervening space and enters the fixed blading clear of the shrouding D. A suction is thus caused at E by the entering jet, while on emerging at F the edge of the jet impinges on the wheel G and produces a pressure which cancels the suction. The pressure difference between the stages is thus taken by the turbine wheels, which are better able to support the load than are the usual partitions.—*March 1st*, 1923.

## TELEGRAPHS AND TELEPHONES.

182,762. January 5th, 1922.—APPARATUS FOR WIRELESS TELEGRAPHY AND TELEPHONY FOR PRODUCING UNDAMPED OSCILLATIONS OF SHORT WAVE LENGTHS, C. Lorenz Aktiengesellschaft, of Lorenz-weg, Tempelhof, near Berlin, and Robert Herzog, of 39, Luisen-Ufer, Berlin.

The object of this invention is efficiently to radiate undamped oscillations of very short wave length, so that the frequency shall not be varied by changes in the generator control, and also that the amplitude shall not vary, except by the variations due to the modulating device. The frequency of the radiation is a multiple of the generator frequency, and is the frequency of the oscillator circuit. The antenna circuit is also tuned to this higher frequency. If the generator circuit A, for example, be tuned to a wave length of 1600 m., then the circuit B is tuned to 800 m., and also the antenna circuit itself. The antenna consequently radiates waves of the latter frequency without the generator circuit being tuned to the same frequency. To avoid alteration of the frequency of radiation during the transmission of signals by the key or a microphone, a resistance C is inserted in the circuit B, which is in parallel with the antenna circuit. The result of this arrangement is that the amplitude of the

N°182,762

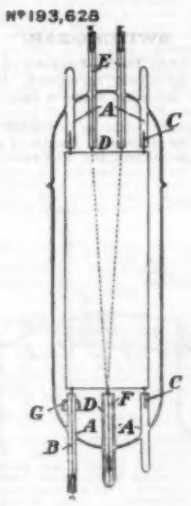



oscillations and of the energy radiated is not subjected to any variation, apart from those produced by the signalling device.—*March 1st*, 1923.

193,628. January 24th, 1922.—IMPROVEMENTS IN AND RELATING TO THE CONSTRUCTION OF THERMIONIC VACUUM TUBES, Lionel George Preston and Benjamin Hodgson, both of H.M. Signal School, Naval Barracks, Portsmouth.

According to this invention, the connecting wires and metal supports of thermionic vacuum tubes attached to the electrodes are efficiently shielded from the discharge so that the conduction in the vacuum tube takes place wholly or substantially so between the electrodes themselves. The shielding tubes A associated with the anode connections, and anode seal B, and

N°193,628

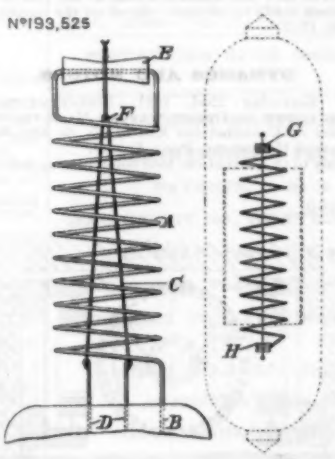



the anode supports C are fused to the envelope of the valve and project well inside the valve. The shielding tubes D associated with the filament leads and seals E and also the filament tension supports F also project well within the valve to shield the metallic wires and supports from the discharge. A simple form of petticoat G is shown fused to the tube associated with the anode seal, and these petticoats or similar insulating arrangements may be associated with the parts to be protected.—*March 1st*, 1923.

193,525. November 30th, 1921.—IMPROVEMENTS IN THERMIONIC VALVES, Sidney George Frost, of the Air Ministry, Alexandra House, Kingsway.

In the thermionic valve described in this specification the grid is utilised as the main support for the filament for the

N°193,525



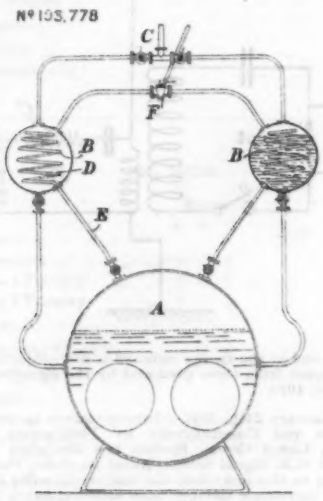

purpose of avoiding or reducing relative movement or vibration of these parts. The grid A is in the form of an open coil of wire, and is mounted at one end B in a glass, silica, or similar seal at the base of the bulb, and the filament C is made in the form of a loop, the legs of the loop being mounted within the grid and

connected to buds D. At the other end the grid coil is connected through an insulator E to the bend F of the filament. In the drawing on the right the filament is supported at its ends by insulators G and H, so that the grid and filament constitute one self-contained unit.—*February 28th*, 1923.

## CONDENSERS AND FEED-WATER HEATERS.

193,778. July 12th, 1922.—Feed-water Heaters, C. Dickie 15, Overdale-villas, Langside, Glasgow.

Above the boiler A there is mounted a pair of tanks B B, each of which is connected with the feed-water supply C, and contains a heating coil D that opens at the upper end into the tank. Steam is supplied to these coils by the pipes E, and a

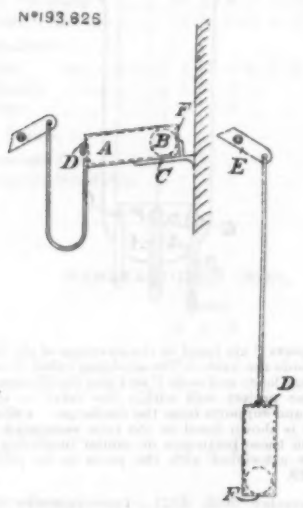



connection to the atmosphere is arranged through the cock F. By manipulating the valves, water can be run into the tanks alternately, heated, and allowed to gravitate into the boiler.—*March 1st*, 1923.

## SWITCHGEAR.

193,626. January 24th, 1922.—Improvements in Retarding Devices for Electric Switches, Automatic Circuit Breakers and the like, William Frisby, of 111, Winnock-road, Colchester.

The object of this invention is to enable a switch or circuit breaker to open after a definite length of time. The tube A contains oil and a metal ball B. The tube is supported on an

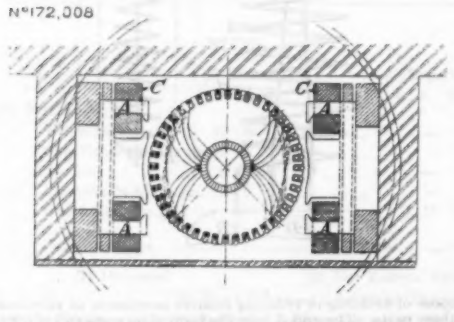



inclined shelf or cradle, and when the ball has gravitated to the end D, the ball overbalances the tube, which then drops, as shown in the right-hand illustration, thus operating the switch lever E. The ball then again descends to the end of the tube, which is then ready to be again placed on the inclined shelf.—*March 1st*, 1923.

## DYNAMOS AND MOTORS.

172,008. November 22nd, 1921.—Improvements in the Commutation of Direct-current Machines, Forges et Ateliers de Constructions Electriques de Jeumont, of 75, Boulevard Haussmann, Paris, France.

According to this invention, four commutating poles are com-

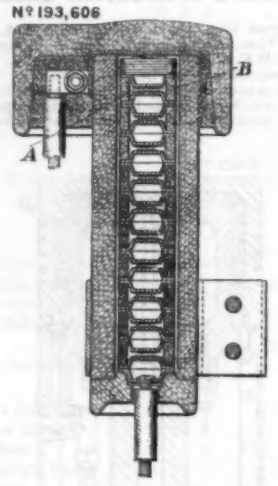



bined with the main pole structure to form four commutating zones round the periphery of the armature without adding to the height of the machine. The poles A form part of the main circuit of the main poles and the flux of the poles A is produced by the current passing through the coils C.—*February 22nd*, 1922.

## TRANSMISSION OF POWER.

193,606. January 10th, 1922.—Improvements in and relating to Protective Devices for Electric Circuits, *The British Thomson-Houston Company, Limited, of* 83, *Cannon-street, E.C.*

This invention relates to lightning arresters having a number of discharge gaps A arranged in series and being entirely enclosed. These discharge gaps are shunted by an insulating resistance, such as porcelain or by material having a lower electrical resistance. Some of the shunt paths B have a very high resistance and

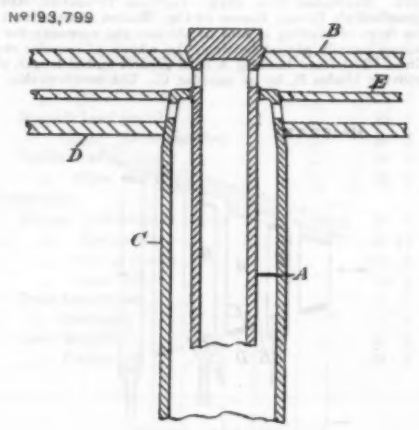



some a lower resistance. By enclosing each of the gaps in a separate chamber, the gas formed by the discharge at each gap is kept away from the other gaps, and it is therefore impossible for the arc formed between any pair of electrodes to extend to any electrode of some other pair.—*March 1st*, 1923.

## MISCELLANEOUS.

193,799. November 23rd, 1921.—Connecting Tubes to Headers, J. L. Musgrave and R. G. Crittall, 197, Wardour-street, London, W. 1.

This specification is concerned with the connection between concentric tubes and their headers having two steam or water spaces, such as are used for radiators. The inner concentric tube A is formed with an inwardly tapering and welded end, the tapering portion fitting into a correspondingly shaped opening in the header cover B. Openings in this tube A communicate with the steam or water space adjacent to the header cover.




The outer tube C is formed with its end tapering in the reverse direction and passes through a correspondingly shaped opening in the header D into a correspondingly shaped hole in the partition E. The extreme end of the tube C is formed with an inwardly projecting tapped flange which screws on to the inner tube A. The connection is made by screwing this tube A further into the tube C, a head being formed on the welded end of A for this purpose.—*February 23rd*, 1923.

193,329. May 9th, 1922.—Improvements in or relating to Leading-in Conductors for Vitreous Material, N. V. Philips' Gloeilampenfabrieken, Gilles Holst, and Dirk Lely, jun., all of Eindhoven, Holland.

The object of this invention is to provide a conductor which will not only seal in a satisfactorily air-tight manner in the vitreous material, but will not damage the latter under temperature changes or be subject to the formation of air leaks at the seal during such temperature changes. In one method of carrying the invention into effect, the metal powders are thoroughly mixed together so that the distribution of each of them is as uniform as possible throughout the whole mass, and they are then heated, preferably in an atmosphere of hydrogen. The metal mixture is conveniently pressed into rods or wires and is then sintered, after which it is hammered, rolled or otherwise swaged and drawn to the desired form. A convenient metal mixture has been found to consist of 59 per cent. of powdered tungsten and 41 per cent. of powdered copper. The resulting conductor is found to have a coefficient of expansion of $9 \times 10^{-6}$.—*February 22nd*, 1923.

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In the "Foundryman's Educator," a little volume by Mr. Arthur Greaves, published at the Foundryman's Education Offices, Harefield Hall, Heywood, near Manchester, the principal features are a list of sixty mixtures for specified purposes and a list of analyses of foundry pigs, but many useful notes about foundry practice are included.

# Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the* time and place *at which the meeting is to be held should be clearly stated.*

### TO-DAY.

Institute of Marine Engineers.—85–88, The Minories, Tower-hill, E. 1. Annual meeting. 6 p.m.

Junior Institution of Engineers.—Cannon-street Hotel, E.C. 4. Annual dance. 6.30 p.m.

Royal Society of Arts: Indian Section.—John-street, Adelphi, W.C. 2. "Postal Telegraph Work in India," by Mr. G. R. Clarke. 4 p.m.

### SATURDAY, APRIL 7th.

Institution of British Foundrymen: Lancashire Branch.—College of Technology, Manchester. Lecture, "Modern Brass-foundry Alloys," by Mr. F. W. Rowe. 3.45 p.m.

North of England Institute of Mining and Mechanical Engineers.—Newcastle-upon-Tyne. Paper to be read: "Demonstrations of Coal Dust Explosions at Eskmeals, 1922" (film), by Professor R. V. Wheeler. Paper for further discussion: "Abstract of Recent American Coal-dust Experiments," by Professor Henry Louis. 2 p.m.

### MONDAY, APRIL 9th.

Society of Engineers.—The Geological Society, Burlington House, Piccadilly, W. 1. Paper, "The Work of the Labour Corps in France during the War, with Particular Reference to the 178th Labour Company," by Mr. T. Exley-Fisher. 5.30 p.m.

### MONDAY AND TUESDAY, APRIL 9th AND 10th.

Institution of Civil Engineers: Newcastle-upon-Tyne Association.—Neville Hall, Newcastle-upon-Tyne. Vernon Harcourt Lectures on "Foundation in Dock and Harbour Works," by Mr. T. R. Wilton. 7.30 p.m.

### TUESDAY, APRIL 10th.

Institution of Civil Engineers.—Great George-street, S.W. 1. Paper, "The King George V. Dock, London," by Mr. Asa Binns. 6 p.m.

Institution of Electrical Engineers: Scottish Centre.—207, Bath-street, Glasgow. Paper by the late Dr. Gisbert Kapp on "The Improvement of Power Factor," will be read by Mr. R. B. Mitchell. 7.30 p.m.

Institute of Metals: Birmingham Local Section.—Chamber of Commerce, New-street, Birmingham. Annual general meeting. 7 p.m.

Institute of Metals: North-East Coast Local Section.—Armstrong College, Newcastle-upon-Tyne. Annual general meeting. 7.30 p.m.

Institution of Petroleum Technologists.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "Potrero No. 4. A History of One of Mexico's Earliest and Largest Wells," by Mr. A. E. Chambers. 5.30 p.m.

### WEDNESDAY, APRIL 11th.

Institution of Automobile Engineers.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Papers: "The Steam Wagon from the Designers' Point of View," by Mr. F. J. Bretherton; and "The Use and Limitations of the Steam Wagon," by Mr. C. le M. Gosselin. 8 p.m.

Institution of Civil Engineers.—Students' Visit to the Golders Green-Edgware Extension of the London Electric Railways.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. "The Application of a Revolving Magnetic Drum to Electric Relays, Syphon Recorders and Radio Transmitting Keys" (experimental demonstration), by Dr. N. McLachlan. 6 p.m.

Institution of Railway Signal Engineers.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. "Some Notes on Railway Accidents," by Mr. G. Holt. 6.30 p.m.

Metallurgical Society: Manchester College of Technology.—Lecture by Dr. Hatfield on "Corrosion in Relation to the Metals used in the Mechanical Arts." 7 p.m.

### WEDNESDAY TO SATURDAY, APRIL 11th TO 14th.

Women's Engineering Society.—The University, Edgbaston, Birmingham. Annual conference.

### THURSDAY, APRIL 12th.

Institute of Metals: London Local Section.—Institute of Marine Engineers, 85-88, The Minories, Tower-hill, E. 1. Annual general meeting. Paper, "The Surface Tension of Metals," by Dr. S. W. Smith. 8 p.m.

### FRIDAY, APRIL 13th.

Diesel Engine Users' Association.—19, Cadogan-gardens, S.W. 3. "The Use of Cooling Water for Diesel Engines," by Mr. J. G. Griffin. Non-members can obtain tickets of admission from the secretary. 3 p.m.

Institute of Metals: Sheffield Local Section.—Mappin Hall of the University, St. George's-square, Sheffield. Conjoint meeting with the Faraday Society and the Manchester Metallurgical Society. 3 p.m.

Institute of Metals: Swansea Local Section.—University College, Singleton Park, Swansea. Paper, "Casting and Castings," by Professor C. A. Edwards. 7.15 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Paper, "Instrument Equipment of Aeroplanes," by Mr. C. B. Clapham. 7.30 p.m.

### TUESDAY, APRIL 17th.

Institute of Marine Engineers.—85–88, The Minories, Tower-hill, E. 1. "The Operation of Water-tube Boilers for Cargo and Passenger Ships," by Mr. R. Clark. 6.30 p.m.

### WEDNESDAY, APRIL 18th.

Institution of Automobile Engineers: Wolverhampton Centre.—The Star and Garter Hotel, Wolverhampton. Paper, "Sleeve Valve Engines," by Mr. E. B. Wood. 7.30 p.m.

### FRIDAY, APRIL 20th.

Institution of Civil Engineers: Yorkshire Association.—Philosophical Hall, Leeds. Paper, "Boiler Plant Economy," by Mr. W. M. Hebblethwaite. 7.30 p.m.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "The Inspection of Ball Bearings," by Mr. C. H. Richardson. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "The Business of Engineering," by Mr. H. L. Munro. 7.30 p.m.